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COVER IMAGE

This shot of Emirates' 100th A380 was provided by BillyPix. Speculation about a follow-on buy at the Dubai air show was short-lived, but it will get more Dreamliners P12



BEHIND THE HEADLINES

The Flight Daily News team was busy at the Dubai air show, producing three bumper issues and our 10-page show report (P12). Jon Hemmerdinger covered Air Transat's 30th birthday, in Montreal (P28)



NEXT WEEK TRAININGWe visit Canada's Hercules training facility at Trenton.
Plus, don't miss our annual Military Simulators census

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Image of the week

Bell Boeing's V-22 Osprey tiltrotor recently passed a combined 400,000 flight hours since service entry in 2007. Flight Fleets Analyzer records 258 MV-22s as in service with the US Marine Corps and US Navy, and 44 CV-22s (*pictured*) with the US Air Force Special Operations Command

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Bell Helicopte

The week in numbers

128%

Flight Dashboard

Q3 operating profit surged to \$107m – but Colombian carrier Avianca has warned a recent pilot strike will hit its Q4 results

\$80_m

Raytheo

Value of a Raytheon contract to supply a telemetry system for the US Navy's new G550 AEW-based range support aircraft

120

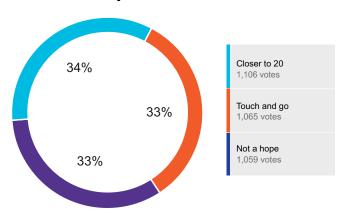
Flight Dashboard

Pratt & Whitney selected to supply PW1100G engines for 60 A320neos for Air China and its Shenzhen Airlines subsidiary

Question of the week

Last week, we asked: Ten more years of A380 production?

Total votes: 3,230



This week, we ask: **F-35 sale to the UAE?**

- \square Would cement closer ties \square Not if it buys Sukhois
- \square Israeli opposition will halt deal

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High stakes

No air show would be complete without a first-day order frenzy, but to concentrate on figures alone misses the underlying face-off taking place between Airbus and Emirates over the A380

To concentrate on the Emirates A380 order saga in anticipation of writing large figures in Dubai air show headlines is to ignore the fascinating high-stakes poker game being played in the background – one involving numbers far greater than a couple of dozen aircraft and a few billions of dollars.

Emirates satisfied those eager for a splash story on the opening day with an agreement for Boeing 787-10s and the unveiling of a luxurious cabin revamp for 777s. It even managed some publicity by proxy as the event began to close, through the huge 737 Max deal reached by partner Flydubai – adding to a sense that Airbus had been left back at the starting gate as far as Dubai's main carrier was concerned.

This is nonsense, of course, because air shows are transient and the absence of a showpiece is hardly evidence of failure when the airline in question has 100 A380s and has expressed, time and again, its devotion for Airbus's double-deck flagship.

At Dubai, Tim Clark appeared both exasperated and baffled over the weak take-up by other airlines

Emirates is passionate about taking the A380 and Airbus is desperate to sell the jet. From the outside, this looks like a shoo-in for both sides, with only the usual fine points to negotiate away.

That is why the real Emirates A380 story at Dubai is not a matter of how many, and how much, but about whether Emirates is calling Airbus's bluff.

Because the airframer has consistently defended the A380, boldly dismissing doubts over its longevity, in the face of an undeniable absence of orders, and assert-



"I raise your 10 years"

ing that the aircraft, born into the darkness of a global economic slump, is yet to have its dawn.

By seeking a guarantee over A380 production for 10-15 years after completing its current orders – effectively the mid-2030s or beyond – the airline is asking Airbus whether the certainty it expresses to the press about future sales is echoed in its own boardroom.

At the Dubai show, Emirates president Tim Clark appeared both exasperated and baffled over the weak take-up by other airlines, and evoked Airbus's own reasoning about traffic forecasts and airport congestion by suggesting that reluctant carriers are engaged in dangerously short-term thinking. Clark has promoted the A380 relentlessly and argues, convincingly, that the airline has marketed the aircraft as much as Airbus – perhaps even more.

Airbus and Emirates, for now, are the only two realistic players seated at the A380 card table. That much is obvious. Less so is which of the two has greater faith in the jet.

See Show Report P12

35-alive

A Lockheed Martin F-22 Raptor and a Sukhoi Su-35 shared a common runway ramp for the first time at the Dubai air show.

As reports heat up of a budding competition between the Su-35 and the Lockheed F-35 for a United Arab Emirates air force contract, that unlikely pairing at Al Maktoum International seemed appropriate.

The UAE has long made known its interest in the capabilities that the F-35 brings to the table. More recently, Russia has claimed the Su-35 is under active consideration and in February signed an agreement with Abu Dhabi to study next-generation fighter concepts.

For its part, the US government appears uncomfortable with these developments. A top US Air Force

commander bristled when asked about the possibility of the two jets operating side by side.

Since the apparent demise of a Russo-Indian pact to develop a variant of the Su-57, the F-35 has held a monopoly on exportable fifth-generation capabilities. No doubt, Washington would like to keep it that way.

What the UAE's true intentions with the Russians are is unclear. Is it simply a negotiating ploy to extract better terms from Washington? Or is it part of a larger geopolitical manoeuvre to offset Russia's Iran-centric approach to the region? Or perhaps a little of both?

In any event, the unfolding fighter competition in Abu Dhabi bears watching. \blacksquare

See Show Report P12



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BRIEFING

INVESTIGATORS PROBE FLYBE NOSE LANDING

SAFETY One passenger received hospital treatment after a 10 November landing incident at Belfast International airport in Northern Ireland involving a Bombardier Q400 operated by UK carrier Flybe. The aircraft, with 57 passengers and crew, landed with its nose-gear not properly deployed, after an approach to runway 25. UK investigators are probing the incident.

EASYJET PICKS TUI CHIEF FOR TOP JOB

MANAGEMENT UK low-cost carrier EasyJet has appointed TUI Group executive Johan Lundgren as its chief executive, to succeed Carolyn McCall from 1 December. Lundgren has spent the past 12 years with the travel operator, serving as group deputy chief and chief executive for mainstream markets.

FIRST C919 ARRIVES AT XIAN TEST SITE

PROGRAMME Comac has flown its first C919 prototype to Xian, marking the start of the next phase in its flight-test and certification campaign. Aircraft B-001A departed Shanghai Pudong International airport on 10 November, completing the 700nm (1,300km) flight in 2h 24min at up to Mach 0.74.

EVA RECEIVES ITS FIRST 777 FREIGHTER

DELIVERY EVA Air has taken delivery of its first Boeing 777 Freighter, and will put the aircraft on services between Asia and North America from late this month, via a technical stop in Anchorage. The Taiwanese operator has another four GE Aviation GE90-powered 777Fs on order, for delivery by 2019.

STAFF SHAKE-UP SOLVES RYANAIR ROSTER ROW

OPERATIONS Ryanair insists it will not experience any further disruption to its operations because of a lack of available pilots, after implementing measures to fix its crew rostering scheme. It has reintroduced a four-week rota as standard, introduced new pay and conditions and is recruiting additional flightcrew.

KUCKO TAKES HELM AT GULF AIR

APPOINTMENT Ex-Croatia Airlines head Kresimir Kucko took the post of Gulf Air chief executive on 12 November, replacing Maher Salman Al Musallam, who left earlier this year. He will oversee the Bahraini flag-carrier's fleet renewal, with 29 Airbus A320neo-family jets and 10 Bombardier CS100s to arrive.

US NAVY DETAILS SUPER HORNET SHORTAGE

READINESS The US Navy's commander of naval air forces, Vice Adm Mike Shoemaker, says the routine "cannibalisation" of parts is affecting readiness. "At the beginning of October, in our [Boeing F/A-18E/F] Super Hornet community alone, only half of our total inventory of 542 aircraft were flyable. Only 31% were fully mission capable and ready to 'fight tonight'."

A400M GEARBOX FIX SLIPS INTO 2018

PROPULSION Work to clear a permanent propeller gearbox (PGB) fix for the Airbus Defence & Space A400M transport will take longer than expected, Europrop International confirms. The engine consortium had targeted approval for modifications to the TP400-D6's Avio Aero-supplied PGB in the third quarter, but is now aiming for certification "at the beginning of 2018". See Feature P42



Gulf state's inventory of French-built type comprises 65 examples

PROCUREMENT CRAIG HOYLE LONDON

Modernisation for UAE's fighter fleet

Nation intends to upgrade its Mirage 2000-9s and F-16s as air force responds to new mission requirements in region

While its years-long search for a future fighter continues, the United Arab Emirates has revealed a plan to modernise its in-service fleet of French- and US-supplied combat aircraft.

During the Dubai air show on 14 November, Dassault confirmed that the UAE's armed forces "have announced their intention to sign a contract for the upgrade of their Mirage 2000-9 fleet".

The company declines to provide further information, but says it "welcomes this decision, and is grateful to the UAE authorities for their trust". It also points to the single-engined fighter's "high-quality participation in international coalition operations".

"The Mirage 2000-9 has proven through time it is one of the best aircraft there is in the operational field," the UAE defence ministry tells FlightGlobal. "The upgrade is to fulfil mission needs and requirements, which have changed based on what is going on in the [Middle East] area. It requires new technologies to be able to operate the aircraft."

Avionics supplier Thales stands to benefit from the prospective contract, having supplied equipment including its radar, mission computer, electronic warfare systems, cockpit displays and helmet-mounted cueing technology.

Flight Fleets Analyzer shows the UAE air force has an active fleet of 55 Mirage 2000-9s, including 14 trainers, plus 10 earlier-generation Mirage 2000s. The assets are aged between 13 and 28 years.

Also at the show, the UAE announced a \$1.6 billion deal for Lockheed to upgrade the capabilities of its almost 80 F-16E/F combat aircraft. The potential modernisation activity was first detailed by the US Defense Security Cooperation Agency in January 2014, when the UAE was also considering the acquisition of 30 additional aircraft in a new Block 61 configuration.

Meanwhile, the UAE will also update its medium transport capabilities, with a new fleet of five Airbus Defence & Space C295s to enter service from the fourth quarter of 2018.

Flight Fleets Analyzer shows the service as currently using six of the earlier-generation CN235, with these aged between 23 and 24 years.

Additional reporting by Stephen Trimble in Dubai See Show Report P12 **ANALYSIS STEPHEN TRIMBLE DUBA**

Orders fly on Dubai's penultimate day

Airbus claims victory over rival after flurry of narrowbody deals make up for failure to bag Emirates A380 commitment

Despite a reputation for calm, the biggest orders at the Dubai air show were saved for the usually quiet penultimate day, with Airbus and Boeing unveiling blockbuster commitments valued at a combined \$76.5 billion at list prices.

Airbus struck first with a \$49.5 billion tentative order from Phoenix-based US investment firm Indigo Partners for 430 A320neofamily aircraft to distribute to

four airlines under its control.

Within an hour, Boeing had hit back, unveiling a \$27 billion agreement with local carrier Flydubai for 175 737 Max aircraft, plus purchase rights for another 50. More than 50 of the first 175 aircraft will be 737 Max 10s, with the remainder -8s and -9s.

The last-minute splurge left some industry observers calling for perspective – and drawing attention to the non-contractual nature of the commitments and delivery timelines starting in four years and stretching nearly a decade into the future.

"It's nothing new to see very large orders," says Aengus Kelly, chief executive of Irish aircraft lessor AerCap. "However, the devil's in the details. Are they firm? Are they commitments? Are they memoranda of understanding? How many of them, when they go to contract, will be firm? And when will they be delivered? Some can be more than a decade away. So you're not necessarily looking at the marketplace today."

Indeed, the commitments announced by Airbus have scheduled deliveries to the four Indigolinked carriers – Frontier Airlines, JetSmart, Volaris and Wizz Air – from 2021 to 2027.

The Dubai event marked possibly the final show appearance by Airbus chief operating officer for customers John Leahy, who plans to firm the Indigo order before he retires at year-end.

Indigo managing partner Bill Franke says Leahy's timeline sets

"Some [deliveries] can be over a decade away. So you're not necessarily looking at today's marketplace"

Aengus Kelly Chief executive, AerCap

an "aggressive" schedule, but it will try to meet the December target. Franke also highlights the dramatic scale of the commitment, as it dwarfs the existing 230-strong combined fleet of the four airlines, Flight Fleets Analyzer records. Prior to the new orders, the combined orderbooks of the four carriers totalled just 247 narrowbodies.

In one swoop, the Indigo deal allowed Airbus to claim that it won the orders and commitments race with Boeing in Dubai, a recovery of sorts after a bruising first day, when Emirates agreed to take 40 787-9s and failed to place an anticipated follow-on order for A380s.

See Show Report P12

Duabi air show commitments

Customer	Aircraft	Quantity	Type		
Indigo Partners	A320neo	430	MoU		
Flydubai	737 Max	175	MoU		
CDB Aviation Lease Finance	A320neo	90	Order		
Emirates	787-10	40	Order		
Golden Falcon Aviation*	A320neo	25	MoU		
ALAFCO	737 Max	20	Order		
EgyptAir	CS300	12	MoU		
SCAT	737 Max	6	Order		
Azerbaijan Airlines	787**	5	Order		
Nordic Aviation Capital	Q400	2	Order		
Air Senegal	A330neo	2	MoU		
Total		807			
Source: Flight Fleets Analyzer Notes: *For Wataniya Airways **Variant to be determined					

PROGRAMME ELLIS TAYLOR DUBAI

C-2 pitched to take up the labours of Hercules

Awasaki Heavy Industries gave a Dubai air show debut to its C-2 tactical transport as it targets export sales of the twinjet.

Powered by a pair of GE Aviation CF6 engines, the aircraft has been developed as a successor to the Kawasaki C-1 for both strategic and tactical airlift missions.

With a 15.6m (51ft)-long cargo compartment, the C-2 is able to carry a maximum payload of 36t over 2,430nm (4,500km); its ferry range is 5,300nm.

"The C-2's capacity sits just in the middle of the [Lockheed Martin] C-130 and the [Boeing] C-17," says Col Tokukazu Omine, programme manager at Japan's Acquisition, Technology and Logistics Agency. "We are quite proud of its capability."

Development of the transport started in 2001, and was completed this March. Tokyo has contracted Kawasaki to produce 11 C-2s, of which four have been delivered to the Japan Air Self-Defence Force.

Omine says the four aircraft are now undergoing operational trials, including reliability tests, paradrops and tactical missions; full operational capability is expected in 2018.

With Japan's government clearing the way to start defence exports, Kawasaki is keen to tap

into the market for C-130 replacements, or for countries requiring a larger strategic airlift capability.

New Zealand and the United Arab Emirates are expected to be strong prospects for sales. However, Omine declines to name specific nations.

He adds that a "variety of countries" have expressed interest in the type, including a number of C-130 operators. ■



ports, Kawasaki is keen to tap | Four examples of tactical transport are undergoing operational trials

PROGRAMME STEPHEN TRIMBLE DUBAI

777X maintains its progress, reaching key design sign-off

Suppliers now in advanced stages of structure production, with Boeing having hit 90% engineering drawing release

Boeing reached the 90% engineering drawing release milestone for the 777-9 on 7 November, vice-president and 777X general manager Eric Lindblad has disclosed.

The key event within Boeing's engineering system signals that suppliers are now in the ad-

vanced stages of production of the parts for the first aircraft.

As expected, progress on refining the design of the primary structure is outpacing that of the aircraft's systems.

Ninety-nine percent of the wing drawings and 98% of the fuselage drawings are now re-



First flight of the GE9X-powered widebody twin is scheduled for 2019

leased, Lindblad says, while the systems drawings are on track to support Boeing's schedule.

So far, five GE Aviation GE9X engines have been run on test stands, and Boeing is "satisfied" with the propulsion system's performance to date, Lindblad says.

Boeing also unveiled the 777X

flightdeck layout at the Dubai air show. As expected, the design is close to the cockpit of the 787, with head-up and large-format, head-down displays.

The differences between the 777X and the 787 flightdeck are few, but significant. The 787's cursor control devices are replaced by touchscreen displays.

The cockpit panels also include detents for raising and lowering the 777X's folding wingtips in automatic or manual modes, Lindblad says.

Separately, 777-9 launch operator Emirates Airline has begun detailing systems for its 150 widebody twins. In the cockpit, it will utilise Rockwell Collins' head-up guidance system, for both the pilot and co-pilot.

The carrier has also extended a pact with Thales to enable the addition of Inmarsat's GX Aviation high-speed broadband.

CABIN DAVID KAMINSKI-MORROW DUBAI

Life gets sweeter in first class, as Emirates upgrades -300ERs

Suites are to be added across Emirates Airlines' incoming fleet of Boeing 777-300ERs, effectively a precursor to the cabin which will feature on its new 777X from 2020.

Emirates has a single -300ER fitted with the cabin and will install the suites, six per aircraft, on around half a dozen of the 15 -300ERs still to be delivered, although the carrier has yet to decide the extent to which it might

retrofit the current fleet.

Airline president Tim Clark says the suites were inspired by its private Airbus ACJ319, and follows a relaxing of criteria allowing the use of enclosed compartments.

"The regulators [initially] wouldn't let us do that," he says, adding that the airline has faced "multiple challenges" ensuring compliance with requirements on lighting and emergency evacua-

tion. Such is the width of the suite that Emirates has adopted a 1-1-1 configuration, but the centre suite will feature artificial windows that will receive a live image transmission from external cameras.

Emirates is working to revamp the first-class suites on its Airbus A380s, but says first-class accommodation on the type would fall as a result. Clark describes the version as a "work in progress".

DEVELOPMENT DAVID KAMINSKI-MORROW DUBAI

Beluga XL preparing for power-on by year's end

A irbus is aiming to fly the first Beluga XL outsize transport in the third quarter of 2018, and achieve power-on before the end of this year. It will undertake a 10-month flight-test campaign before entering service with the company's specialist Airbus Transport International arm.



Current work involves mating the aircraft's vertical fin and tailcone

Just a single aircraft will be used for the campaign. This initial airframe will be fitted with an assortment of flight-test instrumentation.

Airbus states that the attachment of the main freight door of the A330-based aircraft will begin in mid-November.

It says assembly of the Beluga XL is "progressing well" following the introduction of the major structures to the Toulouse line.

The manufacturer has been mating sections for the horizontal stabiliser – including its outboard vertical surfaces – as well as the

A single aircraft will be used for the campaign. This will be fitted with an assortment of flight test instrumentation

vertical fin and tail cone.

Airbus says the initial airframe is also undergoing electrical and mechanical systems installation, while integration work on a second Beluga XL is set to begin "soon".

Dubai 2017 Show Report P12

PRODUCTION STEPHEN TRIMBLE DUBAI

Leap output jumps as recovery spins up

Engine manufacturer CFM accelerates deliveries to 20 per month while also battling high-pressure turbine coating issue

CFM International expects to close a delivery gap for the Leap-1 engine family by the second quarter of 2018 as the manufacturer works to address a spreading technical problem within the engine.

Executive vice-president Allen Paxson acknowledges that CFM is behind schedule on deliveries, slowing planned production ramp-ups for the Airbus A320neo and Boeing 737 Max families.

But the engine maker has started to recover lost ground in recent weeks, he says. CFM reached a delivery pace of 20 engines per week during October – an output level not scheduled to be achieved until the second quarter of 2018.

The acceleration is needed, however, for CFM to catch up with the planned rate of deliveries after falling behind earlier this year, as the 737 Max 8 entered service in May, about nine months after the debut of the Leap-powered A320neo.

As CFM races to catch up on Leap deliveries, it is also tackling a new problem with the coatings in the ceramic matrix composite (CMC) shrouds of the -1A's high-pressure turbine (HPT). So far, CFM has removed 12 engines from the operational fleet that exhibit signs of coatings peeling prematurely.

The problem is not a safety concern, but does increase the exhaust gas temperatures in the HPT



In total, 12 of the -1A powerplants have been removed for upgrade

module by more than 10%, Paxson says. Such temperatures fall within CFM's margin, but could cause the CMC materials to wear prematurely over several years.

CFM plans to introduce an improved coating for the

shrouds into the production system starting in January.

Of the 12 engines already removed, five have been returned to service with a new application of the existing coating chemistry.



DELIVERY

Polished performance from first BBJ2

Poland's government has taken delivery of the first executive Boeing 737-800 intended to serve as an official state transport. Three of the BBJ2 business jets are due to arrive by 2020 under a \$523 million agreement. Polish defence minister Antoni Macierewicz attended the ceremony as the aircraft arrived at Warsaw Chopin airport. The ministry says the aircraft was manufactured in April, and its delivery follows that of two Gulfstream G550 business jets. Warsaw's BBJ2 features a VIP salon and business area for 12 passengers, and an economy section with 48 seats.



SHOW REPORT





WIDEBODIES

'Stellar economics' propelled Emirates to sign Dream deal

Dubai flag carrier orders 40 787-10s after engine performance concerns are overcome

mirates Airline appears to have shrugged off initial concerns over the performance capabilities of the Boeing 787-10 in the hot-weather conditions of Dubai, after agreeing to take 40 of the type from 2022.

President Tim Clark had previously expressed doubts that the aircraft would be able to meet maximum take-off weights, and therefore be unsuitable for the airline's payload-range requirements.

"I think things have moved on," he says, indicating that the agreement is not conditional on technological performance enhancements to the engines. "I don't like thrust bumps anyway."

He had referred three years ago to an engine specification of 70,000-72,000lb-thrust (311-320kN), although GE Aviation's GEnx-1B76 for the 787-10, as well as Rolls-Royce's new Trent 1000-TEN, are rated at more than 76,000lb-thrust. No engine selection has yet been disclosed.

The early margins released when the 787-9 emerged subsequently transformed into "stellar economics", Clark points out, and he is confident the airline will not face operational limitations. He signals that the 787-10 would be used on 7-8.5h sectors where the carrier is looking to raise frequency.

Clark views the 787-10 as a successor to the carrier's R-R-powered 777-300s which, he says, had excellent seat-mile costs. "It was still a hugely profitable aircraft because [Boeing] got it right in the performance box," he says.

FLEXIBLE FUTURE

"We don't need maximum take-off weight to do the missions of the 777-8 and -9," he adds, referring to the future 777X deliveries. "We'll be able to operate at de-rates."

Emirates' commitment to the 787-10s – which includes flexibility on delivery dates, 787 variants and the possibility of additional aircraft – has effectively

"[The 777-300] was still a hugely profitable aircraft because [Boeing] got it right in the performance box"

Tim Clark
President, Emirates Airline

closed the window on the Airbus A350-900, which had been in contention, despite Emirates' high-profile cancellation of 70 A350s three years ago.

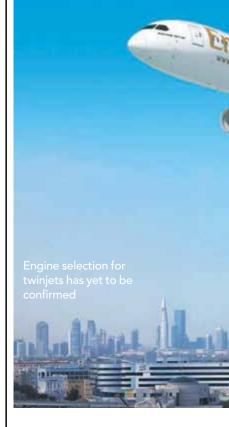
"Never say never," he says, in reference to the A350, but the expression strongly suggests the carrier does not foresee an opening for the twinjet.

Clark suggests Airbus missed an opportunity to improve the A350-900's chances of swaying the decision. He says he looked at the aircraft when Airbus was showing a 10-abreast economy layout, and observed several modifications to the interior — changes to the galley and movement of bulkheads — which opened additional space.

"It was quite a shock to me," he says, claiming he "didn't know about it" — even though the -900 was competing for the Emirates fleet deal — and had asked at the time: "Why didn't you tell me?"

By this point, says Clark, it was a "bit late" to change Emirates' analysis. But he says the -900 is a "more marketable aircraft" as a result, adding: "It's a pity they didn't get it out sooner."

Airbus still stands to gain a fol-



low-on order for A380s from Emirates, but the two sides are continuing a chicken-and-egg wrangle over commitments to the double-deck aircraft's production line.

Emirates' owners have yet to be sufficiently assured that Airbus will keep building the A380 – even though the airline, which is virtually carrying the production line single-handed, naturally has substantial influence on the line's longevity.

In addition, Clark is not particu-

DUBAI 2017 Show report





NEGOTIATIONS

Clark seeks A380 production guarantee

The fluidity of negotiations between Airbus and Emirates on a follow-on A380 deal became embarrassingly clear on the opening day of the show, when an event that was widely expected to focus on an order for the double-deckers instead turned into a Boeing publicity coup as Emirates chairman Sheikh Ahmed bin Saeed Al-Maktoum detailed only the 787-10 agreement.

This surprised onlookers – and a number of Boeing representatives, having attended in expectation of an Airbus revelation, expressing mild bewilderment as the event closed without a mention of their competitor.

Emirates president Tim Clark explains that the carrier is pressing for undertakings that the A380 line will continue for 10-15 years, adding that the airline's ownership is "concerned" that further commitments should "not be [put] at risk" if the line is discontinued.

"I don't believe that [commitment] would be difficult for Airbus to deliver," Clark says, adding that Emirates' backlog of 42 aircraft is already supporting the continuation of the line to the "middle of next decade".

"If it's an Emirates order that sustains the line, so be it," he says.

Airbus has 58 of the type on backlog from other customers, but for some 40 of these there is little evidence of any move towards manufacture.

The airframer has slashed production rates on the type and Clark indicates that the carrier's owners are sensitive to the overall perception of the A380's situation and prospects.

"It remains our flagship," he says. "It's a huge profit-earner for us – the loss of which would be significant." ■

larly enthused by the A380plus upgrades unveiled at the Paris air show this year, stating that while the aircraft offers "small percentages" of improvement, he is "not really" a fan – seeing little benefit to Emirates in the 11-abreast seating or redesigned staircase.

"We'd rather they just offer continuation of the line, flesh out the order, then went [back to] development," he says, adding that the A380 is a "fundamentally good" aircraft which Airbus needs to

promote to carriers which have the "same aspiration" as Emirates.

SEATING CHOICES

He stresses that the aircraft's current configuration works for the carrier and suggests that additional seats only make sense if airline managers believe they can fill them. Clark says he has "not been impressed" by the choices some carriers have made for their A380 cabins, and adds that he believes Airbus specialists already

"We'd rather they just offer continuation of the [A380] line, flesh out the order, then went [back to] development"

Tim Clark President, Emirates Airline

know how to improve the aircraft without raising seat-counts.

Emirates is currently taking delivery of Trent 900-powered A380s. While Clark says he "might contemplate talking to both sides" in the event of a follow-on order, he believes a "revitalisation" of the line would help bring the "big players" together and trigger efforts to improve the aircraft's capabilities.

Clark appears confident that the two sides will eventually reach an agreement. "We need to have that undertaking," he says. "I believe Airbus will deliver that undertaking."



F-35 sale could be scuppered by Russia deal

he US government is discussing the potential sale of Lockheed Martin F-35s to the United Arab Emirates, although a separate agreement between Abu Dhabi and Russia has raised doubts over any future Joint Strike Fighter acquisition.

After the Obama administration pushed back on a previous request from the UAE, the possibility of an F-35 sale appears to have gained renewed traction under President Donald Trump.

Gen Stephen Wilson, the US Air Force's vice chief of staff, speaking at a conference on the eve of the show, confirmed news reports that preliminary discussions with the UAE have taken place.

"Discussions are ongoing on selling the F-35 to partner nations that need it"

Gen Stephen Wilson Vice chief of staff, US Air Force

"As you look here in the Middle East, they share common threats and so we're looking at options on with whom we share those [F-35s] within the Gulf," Wilson says. "So the discussions are ongoing now with the new administration on selling F-35s to partner nations that need them and require them."

However, in February, Abu Dhabi signed a memorandum of understanding with Moscow to develop a fifth-generation fighter, potentially hindering any F-35 sale. In addition, Russia's United Aircraft remains hopeful over the sale of Sukhoi Su-35s to the UAE.

Wilson declines to comment on the issue, but at the same event, Lt Gen Jeffrey Harrigian, USAF head of Central Command, expressed doubts about the interoperability of the two aircraft types.

Israeli objections could also quash any potential deal with the UAE for the F-35.

Cromer 'confident' that new US factory will not face tariffs

Head of Canadian airframer's commercial aircraft operation bullish on CSeries rescue plan

Bombardier intends to start building a \$300 million aircraft factory in Alabama immediately after the CSeries progrmme's sale to Airbus closes - and CS100s delivered to US customers from that facility will not be subject to any import fees, predicts the president of the Canadian airframer's commercial aircraft unit, Fred Cromer.

His comments directly challenge Boeing's firm stance that all CS100s acquired by Delta Air Lines under a 2016 contract should be subject to any tariff imposed by the US Department of Commerce, regardless of where the aircraft are assembled.

"We're pretty confident that airplanes that are produced in the USA with the amount of US content that's already on the aircraft will give us access to that market without the tariffs," says Cromer.

In a thinly veiled jab at Boeing's globally distributed supply



Air Baltic plans to operate exclusively Bombardier narrowbody fleet

chain for aircraft such as the 787, Cromer notes that more than half of a US-assembled CSeries will come from local suppliers.

"I would challenge other aircraft programmes, even some of those built in the US, to demonstrate that they have that much US presence," Cromer says.

In early October, Airbus reached an agreement to acquire a majority stake in the CSeries. As part of the deal, Bombardier will fund a second CSeries assembly line alongside Airbus's A320 plant in Mobile, Alabama.

Bombardier received additional good news in Dubai, with Air Baltic committing to operate an all-CSeries fleet, as well as securing a letter of intent from EgyptAir for up to 24 CS300s, with the deal expected to be finalised by year-end.

MODIFICATION

Armed C295 packs additional punch

irbus Defence & Space is see-Aing strong interest from Middle Eastern and North African nations for a heavily armed variant of its C295 tactical transport.

The manufacturer will soon deliver the first two "light weapguns mounted at the rear para-

onised" versions of the C295 to an unnamed customer. In that guise, the twin-turboprop is fitted with a palletised mission console, multi-mode radar, machine troop doors, and an electro-optical/infrared (EO/IR) turret.

At Dubai, however, Airbus showed off a range of weapons to be integrated on to the platform, including Roketsan Cirit rockets and L-UMTAS missiles, as well as Terber 82 laser-guided bomb kits. The munitions will be mounted on four hardpoints.

It also showed a Rheinmetall 27mm autocannon and door-gun system, which can be controlled from the fully integrated tactical system within the aircraft. A second EO/IR sensor will allow for both surveillance and weapons

Ground testing is set to begin before summer 2018, with the first flight tests due to start in October of that year.



Turboprop will carry range of munitions on four external hardpoints



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LEΛΡ



ORDERS

Going Boeing gives Emirates flexibility

In choosing the biggest 787, the carrier has revived plans to operate a sub-350-seat fleet to open fresh network options

The 40 Boeing 787-10s that Emirates Airline ordered at this year's Dubai air show will provide the carrier with an important new network-development tool when they enter service from 2022.

The Dubai carrier's decision to order the largest Dreamliner variant revives plans to operate a large fleet of sub-350-seaters that were suspended with the cancellation of its Airbus A350 order in 2014.

"We see the 787 as a great complement to our 777 and A380 fleet, providing us with more flexibility to serve a range of destinations as we develop our global route network," says Emirates chairman Sheikh Ahmed bin Saeed Al Maktoum.

The termination of the order for 50 A350-900s and 20 -1000s left the carrier with nothing smaller than the 777-300ER on backlog – an aircraft that seats 354-428 passengers in Emirates' various configurations.

The shift to higher seat-counts became more acute in 2016 when the last of its legacy fleet of A330-200s, A340-300s/500s and 777-200ERs retired. These aircraft seated 237-274 passengers, and their departure left the small sub-fleet of 10 ultra-long-range, 266-seat 777-200LRs as the only below-350-seaters in service with the Gulf carrier.

BEST OPTION

Almost immediately after cancelling its A350 order, Emirates reignited a mid-size widebody evaluation which pitched the A350 against the 787-9/10. Announcing the 787-10 selection, Al Maktoum described the Dreamliner as "the best option", stressing that Emirates' analysis did not focus simply on price.

Emirates says its 787-10s will operate a mix of two- and three-class configurations, seating "between 240 and 330 passengers", and the airline has the right to switch the order to the



Al Maktoum says the Dreamliners will let Gulf airline access to new destinations as it expands globally

smaller 787-9 variant. This offers "additional flexibility for its future fleet and global network", Emirates says.

The fact that it highlights the option to switch is significant, as a move to the smaller 787 variant would indicate a return to the strategy of operating lower-capacity widebodies last pursued with its A330-200s.

When talking to FlightGlobal about the new competition in 2014, Emirates Airline president Tim Clark described the

787-10 as a "10h-capable" aircraft, and indicated the airline had a requirement for a widebody able to serve mediumrange sectors from Dubai where the focus was on good economics rather than ultimate payload/range performance.

PAYLOAD PROBLEM

However, Clark raised concerns at the time that Dubai's harsh operating environment would prevent the 787-10 as then proposed from being able to carry sufficient "We see the 787 as a great complement to our 777 and A380 fleet, providing us with more flexibility"

Sheikh Ahmed bin Saeed Al Maktoum

Chairman, Emirates Airline

payload on critical missions. "The engines are spec'd at 70-72 [thousand pounds thrust], but the conditions we're getting [operating from Dubai means] it can't take the payload," he said in 2014.

Crucially, Emirates is yet to announce its selection between GE Aviation and Rolls-Royce engines to power its 787s.

How Boeing and the engine manufacturers are proposing to tackle these concerns is not clear, but Emirates' decision to place a \$15.1 billion commitment at the show indicates that Clark is satisfied now that solutions have been identified.

Emirates passenger fleet

	In service	On order	Total	Seating range
A380	100	42	142	489-615
787-10°	0	40	40	240-330
777-200LR	10	0	10	266
777-300	3	0	3	364
777-300ER	130	14	144	354-428
777-8**	0	35	35	350
777-9**	0	115	115	400
Total	243	246	489	

Source: Flight Fleets Analyzer. Notes: '787-10 is a commitment, not firm order, and can be switched to 787-9. "777-8/9 seating estimated

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MANAGEMENT

ATR seeks flexibility from restructuring

Reshaping joint-venture manufacturer's corporate make-up will better prepare it for launch of next-generation turboprop

A TR's top executive has indicated that the Airbus-Leonardo joint venture could be restructured into a limited liability company (LLC) to increase management flexibility and financing options ahead of the potential launch of a larger next-generation turboprop.

The joint-venture partners are now considering a complicated legal restructuring aimed at clarifying ATR management's overlapping relationship with its shareholders, which are also primary suppliers for the ATR 72-600 and 42-600, says chief executive Christian Scherer.

It would also create a legal framework for ATR to accept new investors if a development programme for a larger turboprop moves forward, Scherer notes.

"We do want to run a normal business at the pace of a normal

business," he says. "That's what I'm proposing to our shareholders should happen with ATR."

The proposal remains in its infancy. Airbus and Leonardo approved ATR's proposal to study converting the corporate structure from a French business consortium, or GIE, to an LLC. The study has found several complications—including tax and accounting issues—that must be overcome, Scherer acknowledges.

"I cannot say this will take six months [or] a year," he adds. "It takes the time it takes for people to agree. It's certainly not overnight."

For the moment, ATR has time on its side. The manufacturer has lowered output of the turboprop family to 80 deliveries in 2017, although an assembly bottleneck – caused by an undisclosed supplier which is running behind



Regional sales success has come with large commitment from Iran Air

schedule after converting to a new industrial system – threatens to prevent ATR from hitting that target this year, Scherer says.

As the manufacturer works its way through that backlog, ATR's joint-venture partners have been at odds over what to do about launching a larger turboprop with a target capacity of 90-100 seats.

Leonardo has a preference for a

clean-sheet aircraft featuring new propulsion systems, wing designs and cockpit technology that are available today or in a few years' time.

But Airbus favours a slower approach, with an eye to medium-term introduction of a regional turboprop featuring disruptive technologies, such as a hybridelectric propulsion system, and new structural materials.

SALES

E-Jet E2 will hold its own, says Slattery

mbraer is convinced that its sales team needs no external help to win orders for its re-engined E-Jet E2 line, even when faced with the likely marketing might of Airbus behind rival Bombardier's CSeries.

"Nose to nose, the E2, from an operating perspective, is a superior machine," says John Slattery, chief executive of Embraer Commercial Aviation.

Slattery cites the operating economics of the Embraer 190-E2 and E195-E2 versus the CS100 and CS300, which he argues are better on both a per-seat and per-trip basis. "Under those metrics I believe the E2 will win and maintain, if not grow, its market share," he says.

In fact, argues Slattery, Airbus's reinvigoration of the sales effort for the CSeries – once granted US anti-trust clearance – will stimulate the market, giving the



Commercial aircraft boss confident on type's operational advantages

E2 more opportunities in the sub-150-seat sector.

"Once [Airbus] starts marketing that aircraft, my expectation is that the number of campaigns will increase for Embraer."

In the majority of cases, airlines seek multiple bids when acquiring new aircraft, and Em-

braer is the only credible rival for the CSeries, he says.

Slattery expects orders for the E2 – which have been stuck at 285 units – to "pick up in a meaningful fashion" immediately after certification of the E190-E2 in early 2018. He says more than 80% of that process is complete.

AGREEMENTS

Collaborations bring Western firms to region

AE is partnering with the Saudi National Company of Aviation to open a pilot training centre in Dammam, in one of a number of announcements at the show of collaborations between Western and regional companies.

Qinetiq revealed a joint venture with Middle East General Enterprises to produce two of the UK defence contractor's target drones in the United Arab Emirates, and provide training to operators.

Abu Dhabi's Mubadala is teaming with Honeywell to establish maintenance, repair and overhaul capabilities in the emirate for the US firm's auxiliary power units.

Thales is to set up a "defence service centre" in Abu Dhabi to support its products in use with the UAE armed forces.



Boom seeking a power partner

As it works towards service entry in 2023, Boom Supersonic hopes to pick an engine next year to power its developmental 55-passenger airliner and eyes an annual build rate of 100 aircraft.

Company founder and chief executive Blake Scholl says there are "a couple of options in front of us for the production engine".

The start-up is "working through" several possibilities, including a derivative of a current commercial engine or a clean-sheet powerplant for the supersonic airliner.

However, he says it is unlikely that an existing military engine would be selected for the mission. "Certainly that is not our Plan A—there is a level of complexity with export controls," he notes.

Plans disclosed by the compa-

ny indicate that it will use three non-afterburning, medium-bypass turbofan engines for the Mach 2.2 airliner.

In addition, Boom will in early 2018 issue a request for proposals covering the location of its future production facility.

The factory will be sized for assembly of up to 100 aircraft per year, says Scholl, against a forecast market of 1,000-2,000 examples over a 10-year period.

Scholl says the operating economics of the supersonic passenger jet will allow a ticket price of about \$5,000 on the New York-London route – competitive with current business-class fares.

Boom is hoping to fly its XB-1 one-third-scale demonstrator in 2018 to validate the design and control laws of the full-size airliner.



The one-third-scale XB-1 demonstrator is expected to fly next year | Dart-450 to an undisclosed buyer



Developed as a trainer, Dart-450 could also have a suveillance role

PROGRAMMES

Quartet of Diamonds in sparkling show debuts

Diamond Aircraft had a quartet of aircraft on its Dubai static display – all making a first appearance at the show.

Taking pride of place in the Austrian airframer's line-up was a Dart-450 single-engined turboprop, the first of two examples built so far. Chief executive Christian Dries expects the third prototype to make its debut before yearend. The lead pair are powered by the Ivchenko-Progress/Motor Sich AI-450S engine, while the next aircraft will use a 550hp (410kW) GE Aviation powerplant.

Diamond will deliver its first Dart-450 to an undisclosed buver shortly in a non-certificated kit version, and plans to hand over the first fully certificated aircraft in 2018.

The tandem-seat aircraft is developed as a civilian and military trainer, and with an endurance of up to 8.5h, Dries also sees a role for the Dart-450 in the surveillance and reconnaissance markets. "We have had so much interest in this product," he says. "We expect it to be Diamond's most successful model ever."

Also making a show debut were the DA50-V five-seater, DA62 piston-twin and MPP multi-mission variant.

PRODUCTION

Rostec MC-21 plan is surprise for Irkut

State-owned firm discloses pact to build largest variant of new narrowbody in UAE, despite questions over jet's future

Russian state technology firm Rostec has entered initial discussions over possible joint production, with the United Arab Emirates, of a civil aircraft based on the Irkut MC-21-400.

United Aircraft, Irkut's parent, declines to comment on the deal, but FlightGlobal understands that it was not consulted prior to the announcement.

The -400 is the largest proposed version of the Russian twinjet, which Irkut has envi-

sioned as addressing the 240-seat sector.

But the airframer has concentrated on the -300 variant – the first of which flew in May – and appeared to have backed away from developing the -400 in recent years, citing lack of demand.

Irkut publicly lists the MC-21 family as comprising two versions: the -300 with 163-211 seats and the -200 with 132-165 seats.

But the preliminary UAE pact disclosed at Dubai could involve

the resurrection of the -400, with production taking place in the Gulf state; Rostec describes the -400 as a 250-seat aircraft.

"We will create a working group to discuss it further," says Rostec chief executive Sergei Chemezov.

Rostec aircraft leasing subsidiary Aviakapital-Servis is a customer of the MC-21, with orders for up to 85 of the type. But the diversified state firm also has interests in several suppliers to the

programme, such as Technodinamika, Khimkompozit, KRET and United Engine, which is developing the Aviadvigatel PD-14 as an alternative powerplant for the twinjet.

Rostec disclosed the initial UAE discussions over the MC-21 partnership following a 12 November meeting with Abu Dhabi crown prince Sheikh Mohammed bin Zayed al-Nahyan, the brother of UAE president Sheikh Khalifa bin Zayed Al Nahyan.

PROGRAMME

Bell takes heart from Valor's progress

New tiltrotor on course for maiden sortie within weeks, as airframer prepares for US Army's Future Vertical Lift contest

Although Bell Helicopter's immediate attentions at Dubai were centred on the sale of AH-1Z attack helicopters in the region, back at its Amarillo, Texas facility the focus remains on achieving first flight of its latest rotorcraft.

The airframer plans to perform a maiden sortie of the V-280 Valor tiltrotor before "the end of the autumn", says Vince Tobin, vice-president military business at Bell, ushering in a frantic period of test activity as part of a broader US Army-led effort.

Initially to fly as part of the joint multi-role technology demonstrator programme, Bell hopes the V-280 will then form the basis for the multiservice future vertical lift (FVL) initiative, initially as a replacement for the army's fleet of Sikorsky UH-60 Black Hawks.

Ground runs of the Valor's GE Aviation T64 powerplants have been taking place for the past two months; recent trials have also seen the aircraft rotate its engines between 75°-95°.

"It is restrained on the run stand, so we have actually had both engines turning simultaneously with greater than take-off



Tobin says Osprey could incorporate technologies from the V-280

SALE

Viper could thrive in Middle East's heat

Bell Helicopter is confident that the Middle East can deliver a sales boost across its military product line, with a number of campaigns currently active centred on the AH-1Z Viper attack rotorcraft.

Doug Wolfe, Middle East regional director for military business development, says the AH-1Z is the "most capable, most modern attack helicopter flying today" and is gaining "significant interest" across the Middle East.

The Viper is already in operation with the US Marine Corps,

and Bell is hopeful that the Middle East can generate additional sales. So far, Pakistan is the sole export customer for the type, with an order for 12 helicopters.

Wolfe cites the in-built levels of marinisation – "it's built to live on a ship", he says – as a key selling point for the region, where that protection "also works very well in desert environments".

While Wolfe declines to name potential buyers, Bahrain is one obvious sales prospect, and the United Arab Emirates could be another possibility.

power through the rotor system," says Tobin. "We like to say that it's actually sling-loading the Earth at the moment."

Initial flights will be confined to low hover manoeuvres, before moving to transitions into airplane mode, and then an expansion of the envelope in airplane mode "by the spring of 2018", says Tobin.

Although the V-280 faces competition for the FVL contract from the co-axial-rotor Sikorsky-Boeing SB-1 Defiant, first flight of the latter has been pushed back into 2018.

While confined by the timeline of any potential future contract, Bell believes it could be in a position to begin the engineering, manufacturing and development phase of any programme of record by 2021, says Tobin.

He says some of the technologies being developed for the Valor, notably the manufacturing processes for the wing, could be adapted for its existing V-22 Osprey tiltrotor if the US Department of Defense chose to launch an upgrade programme for the type. The V-22 is built in partnership with Boeing.

ROTORCRAFT

Cutillo inherits headaches at Leonardo Helicopters

With five years as the chief financial officer of parent company Leonardo under his belt, Gian Piero Cutillo is now facing up to a new challenge as managing director of its helicopter division.

Cutillo was appointed just five weeks ago and the Dubai show marked his first major exhibition in the new role.

As well as having to deal with a flatlining market for helicopter sales, Leonardo has been battling its own internal problems, which have seen the rotorcraft division – home to the AgustaWestland brand – singled out for poor performance in the company's recent third-quarter financial results.

Although Cutillo concedes that the division needs to improve in some areas to "better answer to the challenge of the market", he believes there is still a strong underlying business.

Leonardo Helicopters will show a year-on-year delivery decline in 2017, he says, as the operation battles not just a segment-



New managing director spent five years as group finance chief

wide slump, but production issues driven by "a lack of visibility" in its backlog. "It doesn't allow you to plan production correctly," he says.

That issue has been compounded by "teething troubles" with the production and in-service reliability of its new AW169.

Nonetheless, the Pratt & Whitney Canada PW210A-powered medium-twin has continued to pull in orders, scoring a three-unit deal at the show from Abu Dhabi's Falcon Aviation Services.

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TAI jet plan could be trouble for rival

State-run manufacturer proposes 100-seat regional aircraft, but development may cast doubt on SNC's ongoing effort

urkish Aerospace Industries (TAI) has unveiled ambitious plans for the launch of an allcomposite regional airliner within five years as part of a decadelong masterplan.

However, the proposal floated by TAI chief executive Temel Kotil risks scuppering a separate Turkish regional aircraft programme being driven by US firm Sierra Nevada (SNC).

Speaking at the show, Kotil confirmed TAI's interest in the sector. It is examining the potential for a "100-seat-plus" aircraft to be launched in about five years' time, once its existing development programmes have transitioned to serial production and the company has gained sufficient design expertise.

"At that time I'm planning to start a passenger aircraft programme, but not today - I am too busy with defence programmes," says Kotil.

"So there is no room for a passenger machine, but five years later in my hand I will have several hundred well-trained people. And that time, under our 10year masterplan, we will [start] the passenger aircraft also."

Describing it as a jet-powered

aircraft, made from "full composite" material - potentially thermoplastic, rather than thermoset - Kotil says it "should be more efficient than existing narrowbody aircraft, maybe as efficient as the 787 in terms of seatkilometres".

He adds: "But this is a future project and we cannot start before five years.'

TAI's ambitions in the segment may spell the end for plans, outlined by SNC over the past three years, for the development of a family of Turkish-built regional aircraft.

SNC had proposed a dual-track approach to the market following its February 2015 acquisition of 328 Support Services, the type certificate holder for programmes under the Dornier 328 banner.

SNC - via its TRJet subsidiary - intended to develop modernised versions of the Do328 turboprop and jet. It had gone as far as to select Pratt & Whitney Canada as the engine supplier. Further out, it plans bring to market a clean-sheet aircraft with 50-70 seats for service entry in about 2023. But despite great initial fanfare, there has been little further detail released.



Airframer intends to build next generation of T129 attack helicopter

STRATEGY

New chief Kotil locks on to growth target

After only a year in post following his October 2016 appointment, Turkish Aerospace Industries' (TAI) chief executive Temel Kotil is targeting ambitious growth to turn the company into a major international player.

Along with its ongoing T129 ATAK attack helicopter, Anka unmanned air vehicle and Hürkuş turboprop trainer, TAI has a number of developments on the go.

These include the T625 intermediate twin-engined helicopter, as well as a number of more ambitious efforts.

TAI recently unveiled its advanced trainer and light attack concept, the Hürjet, and plans to make a decision early next year on the engine for its indigenous fifth-generation fighter, the TF-X. It is also working on the ATAK 2, a heavier variant of its T129, and a 10t general purpose helicopter.

This will be enough income to turn us into a global player," Kotil says.

The Hürjet trainer is based on the Hürkuş and is designed to serve as a developmental stepping stone towards TF-X.

Calidus joins light-attack fray with B-250 turboprop

alidus, based in the United ◆Arab Emirates, unveiled its B-250 light-attack aircraft, designed for close-air support and counter-insurgency missions.

The all-new aircraft, powered by a Pratt & Whitney Canada PT6A-68 engine, has been developed over only a two-year period, in conjunction with Brazilian aerospace company Novaer.

Using a carbonfibre airframe, it also features a Rockwell Collins Pro Line Fusion avionics suite.



Bearing a similarity to the Em- | Aircraft was developed with Brazilian aerospace company Novaer

braer Super Tucano, the B-250 has been designed from the ground up as a strike aircraft, rather than a platform adapted to the role, which Calidus says gives it a major advantage.

The aircraft can be equipped with seven weapons mounted on external hardpoints, along with a podded electro-optical sensor.

Sources close to the company say the aircraft has already generated significant interest. Production is in its early stages at Calidus's facility in Al Ain.



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FLEET JAMIE BULLEN LONDON

Pre-owned A380s prove tempting, as initial retiree lands

Dr Peters discussing sale of ex-SIA superjumbos to British Airways, with first aircraft now in storage at Tarbes facility

German asset manager Dr Peters is in talks with British Airways and other prospects on the potential sale of Airbus A380s as it prepares to receive four of the jets back from lessee Singapore Airlines (SIA).

"We are in discussion with a number of potential buyers, including British Airways and a number of other European flag carriers as well as Asian low-cost airlines," Anselm Gehling, Dr Peters' chief executive, tells Flight-Global.

"A number of freight companies are also showing interest for freighter conversion, including one of the world's largest cargo shippers." Portuguese wet-lease specialist Hi Fly, which has indi-

cated an interest in the double-deck type, is "also welcome to have discussions with us", Gehling says.

BA declines to comment, but at an Airline Economics Growth Frontiers conference in January 2016, IAG chief executive Willie Walsh raised the prospect of subsidiary BA adding "five or six" second-hand A380s to its 12-strong fleet of new-build examples.

Additionally, Gehling, in a repeat of the comments made by Emirates Airline president Tim Clark at the Dubai air show, calls on Airbus to show clear support for the A380's future.

"I echo his words and think Airbus needs to commit to pro-



BA is interested in adding several second-hand examples to its fleet

ducing it for a another 10 to 15 years at least, to ensure not only new orders but a secondary market for this aircraft."

Tarbes-Lourdes airport recently received the first Dr Peters A380 (MSN3), which is being placed in storage following its withdrawal from SIA's fleet.

As an interim solution until a buyer is found, Rolls-Royce is paying Dr Peters a fee for the use of the Trent 900 engines, Gehling says.

"We expect this arrangement |

can be rolled out for the other three SIA A380s we have under management. When we find a buyer, the aircraft will go through a shop maintenance visit and have fully updated engines attached for the new user."

Teardown of the aircraft also remains a possibility, he says, but admits this would be a "sad" outcome.

Dr Peters has nine A380s: Air France is leasing five, while the remainder are operated by SIA.

See Show Report P12

PROGRAMME DAVID KAMINSKI-MORROW DUBAI

Irkut starts next MC-21 and second waits in wings

rkut has commenced final assembly of the third prototype MC-21-300, as it prepares to transfer the second to the manufacturer's flight-test arm.

The Russian airframer is expecting to carry out about 1,000 flights during the certification campaign for the Pratt & Whitney PW1400G-powered twinjet.

Irkut says that it is aiming for Russian type certification in mid-2019 and similar approval from the European Aviation Safety Agency in mid-2020.

The MC-21 has been undergoing operational tests for nearly six months, following its maiden flight on 28 May.

Irkut says 20 flights were conducted for early development



Airframer is modifying assembly lines to prepare for serial production

analysis at its Irkutsk plant, before the aircraft was flown to the flight-test institute at Moscow's Zhukovsky airfield. It began test flights from Zhukovsky two weeks later, on 2 November. The aircraft is being housed in a new hangar at the Yakovlev flight-test complex, which features ground-testing and information-exchange capabilities. "Systems are being tested and software is being debugged," says Irkut.

The second aircraft is being prepared for handover to the flight-test division and the third will follow in 2018, it adds.

Irkut is also carrying out certification work on test benches, with testing completed at 22 of the 56 benches in operation.

It is modifying its Irkutsk assembly lines with additional stations to cope with serial production, putting capacity of the line at 20 aircraft per year, and will also complete construction of an MC-21 logistics centre at the plant next year.



New livery for transformed Air Transat Air Transport P28

FLEET GHIM-LAY YEO WASHINGTON DO

Azul E-Jet sales fuelling Neo transition

Carrier accelerates disposal of Embraer types to capitalise on A320's greater fuel efficiency for upgauging domestic routes

Parazilian carrier Azul is progressing talks to accelerate the sale of its Embraer E-Jets, in a bid to pull forward deliveries of Airbus A320neos.

David Neeleman, the airline's founder, told investors on an earnings call on 9 November that he hopes to deliver "good news" on that front at the time of its full-year results, scheduled during February 2018.

"We are moving aggressively," says Neeleman, adding that the airline has seen strong demand in the market for used E-Jets. The carrier is in talks with "different entities to sell them quicker and bring on the A320neos quicker", he confirms. "Our commitment is



The airline should have 17 re-engined narrowbodies by end of 2018

to stay metal-neutral, but we want the more efficient aircraft in our fleet."

Azul has repeatedly praised the performance of the A320neo since it began revenue service with the type in November 2016. Chief executive John Rodgerson has described the re-engined narrowbody as an "unbelievable fuel machine". The carrier says it has observed a 29% advantage in

unit costs on the A320neo over the Embraer 195. The airline is using the A320neo to upgauge domestic routes that were previously operated with the E-Jet.

Azul operates eight A320neos, and will add another three in the fourth quarter of this year. Neeleman says it will introduce seven of the type between November and January, just in time for the high travel season in Brazil. Azul's fleet plan shows that it will be operating 17 A320neos by the end of 2018.

The carrier flies 10 E190s and 60 E195s, and will be the launch operator for Embraer's re-engined E195-E2, which is scheduled for delivery in 2019.

MRO AARON CHONG SINGAPORE

Ameco Beijing gears up to provide Max support



Air China took delivery of the first of its eight 737-8s early this month

M aintenance, repair and overhaul operator Ameco Beijing has been approved to maintain the Boeing 737 Max 8, and has started work on China's first example.

The company says it is supporting Air China's new 737-8, after receiving approval from the Civil Aviation Administration of China to provide line maintenance, scheduled checks, modifications, engine changes and auxiliary power unit replacements

on the re-engined narrowbody.

Ameco's training centre is also the first in China to provide 737 Max training. A first course began at its Beijing headquarters on 6 November, with an intake of 24 mechanics.

Flight Fleets Analyzer shows that Air China operates a fleet of 388 aircraft, including 139 737s and 59 Airbus A330s. The carrier early this month took delivery of its first 737-8, from an initial eight-unit order.

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TRANSITION JON HEMMERDINGER MONTREAL

New livery for transformed Air Transat

Design unveiled on A330-200 is part of major renewal programme launched following investments by Canadian rivals

Canadian leisure carrier Air Transat unveiled its new livery in a ceremony marking the company's 30th anniversary on 13 November in Montreal.

The new design, painted on an Airbus A330-200, comes as the Montreal-based carrier embarks on a major fleet transition where it will retire ageing A310s and acquire new A321LRs.

Newly-painted C-GTSN has a white fuselage bearing the airline's name in blue, and a light blue tail emblazoned with the carrier's star logo, which is also shown on the winglets. It was painted in Rio de Janeiro, with decals added after its

return to Canada. The design marks a change from the previous livery, which had a darker tail and a blue star emblem.

The airline – a division of tour company Transat AT – will now begin the process of repainting the other A330s in its fleet.

Air Transat made its inaugural flight on 14 November 1987, from Montreal to Acapulco.

Speaking prior to the anniversary event, chief executive Jean-Marc Eustache described Air Transat as having evolved into an integrated tour operator that owns an airline, hotels and a wide distribution network.



He describes Canada's aviation industry as increasingly competitive, but says Air Transat is adapting by updating its fleet with new A321LRs. In July 2017, the carrier announced that it had signed an

agreement to lease 10 of the longrange type from AerCap, with deliveries due between early 2019 and the third quarter of 2020.

It later signed a fleet-sharing deal with Thomas Cook whereby the Canadian company will operate some of its partner's A321s during winter, while the latter will use at least one of its A330s.

Air Transat primarily operates two distinct route networks: one connecting major Canadian cities to European leisure destinations, and the other linking Canada to warm-weather destinations in the USA, the Caribbean, Central America and Mexico. It faces competition from rapidly-expanding Air Canada, as well as WestJet, which has announced orders for Boeing 787s as part of an international growth plan.

See Feature P32

FLEET

Cockpit commonality drove selection of A321 over new 737s

Pilot commonality led Air Transat to choose Airbus A321s over Boeing 737s, says the carrier's president, Jean-François Lemay.

"The main challenge for an airline is to optimise the utilisation of its heavy assets. So we decided to go with an all-Airbus fleet," he says.

The carrier's fleet includes 14 A330s, seven A310s and a mix of 10 737-700/800s, Flight Fleets Analyzer shows.

Earlier this year, it announced plans to replace the A310s and 737s with a mix of A321s and A321LRs. The A321s could arrive from March 2018, while the first of 10 A321LRs are scheduled for delivery in early 2019.

Lemay says the airline's current mixed fleet of Airbus and Boeing types limits efficiency. Because pilots cannot switch easily between Airbus widebodies and 737s, it typically cannot schedule them to fulfil their full allowable monthly flying hours. Seasonal demands also require some pilots to undergo substantial crossover training, he adds.

By contrast, pilots switching between the A330 and A321 will benefit from cockpit commonality, requiring less intensive "cross-crew qualification". This means Air Transat could schedule pilots to operate both types during a single trip, Lemay notes.

RETIREMENT GHIM-LAY YEO WASHINGTON DC

Allegiant bids farewell to 757s and Hawaii service



Operator's last example flew from Las Vegas to Honolulu in October

as Vegas-based Allegiant Air has phased out its final Boeing 757-200s, marking an end to the carrier's Hawaii service.

"Both 757s are retiring as part of the ongoing fleet transition," the carrier says, confirming that the type's final service was operated on 28 October, between Las Vegas and Honolulu.

Allegiant is in the process of replacing its MD-80s with Airbus A320-family aircraft. The airline acquired six 757s in 2010 to launch services to Hawaii from 2012. However, it cut most of the flights one year later, citing insufficient demand and the high costs of operating the Boeing twinjets.

The carrier initially planned to halt services to Hawaii in August 2016, but extended this by a year after experiencing better-than-expected performance on the Las Vegas-Honolulu route. Flight Fleets Analyzer shows Allegiant's last two 757s were parked in October and November.



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Boeing steps up Middle East tanker campaign



Tanker variant of 767 still needs to overcome refuelling boom issue

Boeing's troubled KC-46A tanker development programme is nearing resolution, as the company steps up its efforts to promote the 767-based type to potential customers in the Middle East.

Leanne Caret, chief executive of the company's Defense, Space and Security unit, expects only one outstanding deficiency in its development activity for the US Air Force to remain after this month. Boeing is continuing to work with service officials to find a solution for the issue, which concerns the remotely-operated refuelling boom.

Caret says the Middle East is a critical piece of Boeing's export strategy for the new tanker, and is already marketing the KC-46A to potential buyers.

"There's almost never enough [tanking capability], and assets are being used and shared across the region," says vice-president of global sales Gene Cunningham. "In many cases I think customers will be trying to add capability and not substitute."

PROGRAMME ELLIS TAYLOR DUBAI

KC-390 nearing return after stall testing incident

he Embraer KC-390 protoype involved in a stall speed incident on 12 October has not been significantly damaged and is set to return to flight testing soon following minor repairs.

Embraer says that the aircraft, 001 (PT-ZNF), "experienced an event beyond the planned limit" during a simulated icing test, which took the aircraft beyond its airspeed and load factor operating limitations. That forced the crew to apply recovery procedures, and the aircraft returned to the company's test base at Gavião Peixoto. It has not been flown again since the incident.

The airframer says a detailed inspection showed that there was no damage to the primary aircraft structure, but that some external fairings and access hatches will be replaced before it can resume flight testing.

"The KC-390 certification schedule is not affected, and entry into service is confirmed for 2018, with the delivery of the first production aircraft to the Brazilian air force," the airframer confirms.

The service is expected to take its first two of an eventual 28 of the transport/tankers next year.

PROPOSAL DOMINIC PERRY DUBAI

Italy seeks partner nations to join in AW249 development

Leonardo Helicopters says proposed new attack rotorcraft can be "basis for collaboration"

eonardo Helicopters is looking for additional partners on its new attack rotorcraft programme, now designated the AW249.

In January 2017 Italy awarded the company a €487 million (\$515 million) contract to develop a successor to its army's AW129 Mangusta fleet. But speaking at the Dubai air show, Leonardo's group chief commercial officer Lorenzo Mariani said the helicopter is "not only for Italy".

"It is a basis for collaboration we believe other nations can join this project," says Mariani, confirming the AW249 designation.

"We have the contract, we have the design, we have the idea and we have started the development - we are open for other nations to join that."

Mariani's comments raise the possibility that Leonardo could once again partner with Turkish Aerospace Industries, which has already signalled an intention to develop a successor to the T129 ATAK, a helicopter derived from the Mangusta.

Further details on the AW249's proposed specification have also emerged. A presentation given by the Italian army at a conference in Kracow, Poland, indicates that the helicopter will have a maximum take-off weight of 7-8t: significantly higher than the 5t AW129. This increase is partly driven by a more than doubling of the aircraft's weapons load, from 800kg (1,760lb) to almost 2,000kg.

Cruise speed, operating ceiling and endurance figures on the AW249 would all increase compared with the Mangusta, and Leonardo proposes examining the new helicopter's radar and heat signatures to give it more stealthy characteristics.

No decision has been made on the AW249's engines, but it is likely to be a two-way fight between the GE Aviation T700 and the Safran Helicopter Engines Aneto, recently selected to power the commercial AW189K.

The development contract runs until 2025 and will see Leonardo produce a total of five aircraft. Italy projects an eventual requirement for 48 helicopters, with its Mangusta fleet to be retired from 2025.



Rome wants its Mangusta replacement to be available from 2025

Home skies debut for Norwegian F-35s

Arrival of trio marks milestone in Oslo's programme to make the fifth-generation fighter fully combat ready by 2025

■he Royal Norwegian Air Force has conducted its first domestic flights with the Lockheed Martin F-35A, after a trio of the fifth-generation type touched down at its Ørland air base early this month.

Oslo's lead arrivals from an eventually 52-strong fleet were formally welcomed during a 10 November ceremony, following their acceptance by its Defence Materiel Agency.

The F-35As had landed at Ørland on 3 November, after a 9h 22min delivery flight from Lockheed's Fort Worth plant in Texas conducted by US pilots. They were met on entering Norwegian airspace by a pair of Lockheed F-16s - the type they will be replacing in service.

Norway has so far received 10 F-35s, including four that will remain permanently at the US



New type is due to achieve initial operational capability during 2019

Air Force's Luke AFB in Arizona to support multinational pilot training activities. The jets flown to Ørland early this month are its most recent examples, carrying the tail numbers 5148-5150.

'This marks the start of reaching the next milestone: making Royal Norwegian Air Force chief of staff Maj Gen Tonje Skinnarland. The new type is scheduled to achieve initial operational capability status with the service during 2019, and to be declared fully operational in 2025.

"From 2018, Norway will the aircraft combat-ready," says I receive six aircraft annually up until, and including, 2024," the nation's defence ministry says. Maj Gen Morten Klever, its F-35 programme director, notes that Oslo's acquisition is "delivering on all key criteria: time, cost and performance".

Lockheed recently delivered a full-mission simulator for the F-35 to Ørland. It will support "pilot qualification, continuation and mission-rehearsal training".

Meanwhile, a braking parachute modification developed to support Norwegian operations on short and icy runways will be tested at Eielson AFB in Alaska later this year, Lockheed says. Oslo's aircraft will also be equipped with the internally carried Kongsberg Defence Systems Joint Strike Missile, which will be capable of attacking land and maritime targets from a range of up to 150nm (277km).

REQUIREMENT GREG WALDRON SINGAPORE

Malaysia eyes options to buoy maritime capability

Kuala Lumpur appears to have taken a step closer to obtaining a maritime patrol aircraft (MPA) capability, following a recent budget allocation.

State news agency Bernama reports that the Royal Malaysian Air Force has set up a team to evaluate MPA candidates, following a provision made in the government's 2018 budget for the acquisition of four aircraft.

The report, quoting air force

chief of staff Gen Affendi Buang, notes that the participation of local industry will be a key factor.

Located in a vast littoral region riven with competing territorial claims, Malaysia has a clear need for long-range patrol aircraft, with the mission currently performed using four Beechcraft King Air twin-turboprops.

Kuala Lumpur's maritime patrol needs have been a common theme at the biennial LIMA de-



Airbus has demonstrated a surveillance variant of C295 turboprop

fence exhibition in Langkawi, most recently in March 2017. Airbus Defence & Space, Boeing, Indonesian Aerospace, Leonardo and Saab have all promoted potential solutions at the biennial

event. Leonardo chose this year's iteration for the public debut of its ATR 72MP, while Airbus demonstrated a maritime surveillance derivative of its C295 in the country after June's Paris air show.

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Airbus twin still peaking

Toulouse's redoubtable A330 has undergone a remarkable evolution over the last 25 years and, as tests begin of an upgraded variant, is showing no signs of slowing down

MAX KINGSLEY-JONES LONDON

hisper it, but the recent first flight of a second-generation Airbus A330, the re-engined -900, was tantalisingly close to the 25th anniversary of the twinjet's maiden sortie on 2 November 1992. Understandably, Airbus has not made much of this historic milestone, but the fact is that the aircraft's continuing appeal in a market of much younger competitors is a credit to the A330's original concept, which dates back to the 1980s.

"Like a human, today's A330 is very different to how it was 25 years ago. The yesterday and today are very different," says Airbus's A330 marketing chief, Crawford Hamilton.

The A330-900 that kicked off the Neo flighttest programme on 19 October may have the same dimensions as the original A330-300, but the twinjet has evolved considerably. The major difference centres on Rolls-Royce Trent 7000 engines, key to delivering a double-digit percentage improvement in efficiency. But the other changes go more than skin-deep, covering revised aerodynamics and sharklets, higher weights and the latest A350-derived passenger cabin (see graphic).

Hamilton is confident that the latest variants can enjoy similar success to the v1.0: "We've always reckoned there's a market for

over 1,000 A330neos. And given that we've sold over 1,400 of the current A330, there should be at least a 1,000 out there," he says.

The arrival of the A330-300 in 1992 was significant in itself, being Airbus's first "big twin" and conceived as a larger-capacity, longer-range (but not long-range) successor to the original "air bus", the A300B. In parallel, Airbus developed the long-range quad A340 family as a sister design based on the same fuselage, wing and related systems. The two models were developed side by side because during the pre-launch phase in the 1980s, potential customers could not decide whether they wanted two or four engines.

TWIN OR QUAD?

"North American operators were clearly in favour of a twin, while Asia wanted a quad. In Europe, opinion was split between the two," the now-retired Adam Brown told *Flight International* back in 1998 when he was Airbus vice-president strategic planning.

Brown said Airbus chief engineer Jean Roeder enabled the two designs to effectively become one, by creating a common wing structure. "The [development] cost savings this presented enabled us to do both aircraft."

Studies crystallised around the A330/A340 designations in 1986 as the next Airbus types after the A320 single-aisle. Customer interest



A330neo specifications

	A330-800	A330-900	
Length (m)	58.8	63.7	
Wingspan (m)	64	64	
Height (m)	17.4	16.8	
MTOW (t)*	242	242	
MLW (t)	186	191	
MZFW (t)	176	181	
Fuel capacity (I)	139,010	139,090	
Seating (2-class)	257	287	
Powerplant	R-R Trent 7000	R-R Trent 7000	
Thrust (lb)	72,000	72,000	
Range (nm)	7,500	6,550	
Orders	6	206	
·	·	<u> </u>	

*251t option in development Source: Airbus

meant the quad led the development programme, which resulted in an amusing debate about the designations.

As lead variant, the quad was initially dubbed the A330, while the twin became the A340. "Then our salesmen came back and said that airlines would never get their brains around a twin having a 'four' in its name and the quad not... so we reversed the designations," said Brown in 1998.

While the A330 moved forward with GE Aviation CF6 power, Airbus adopted a version of the A320's CFM International CFM56-5 for the quad. A330 engine options were quickly expanded to include the Pratt & Whitney PW4000, and in a first for Toulouse, an engine from Rolls-Royce, the Trent 700.

Full go-ahead came just before the 1987 Paris



When the longer-range A330-200 arrived in 1998, it gave Airbus a true rival to the 767-300ER



air show and the programme quickly moved into its stride. The A340 took to the air in October 1991 and the A330 testing began just over a year later, on 2 November 1992. At the time, Airbus had secured 270 orders for the two types, about half of which were for the twinjet.

French domestic carrier Air Inter was the first to introduce the A330, starting services in January 1994 between Paris and Marseille with its aircraft configured in a very high count for a twinjet at the time – 412 seats.

The A330 was initially seen as the mediumrange sister to the long-range quad. But the advent of long-haul twin-engined operations changed perceptions and any lingering doubts about twins' suitability to fly across oceans and empty landmasses. This meant that range development of the A330 was crucial if Airbus was to challenge its US rival in the sector.

Cue the A330-200 "shrink", which entered service in 1998 and finally provided Airbus with a direct competitor to the Boeing 767-300ER. The little sister was an instant hit, leading the way to establishing Airbus as a genuine player in the long-range twin sector.

Hamilton says the A330 "is now on a trend to becoming the preferred entry-level wide-body – we knocked the 767 off its perch about four or five years ago".

In 2000, Airbus briefly flirted with an even longer-range double-shrink derivative, the A330-500, before concentrating on developing the existing family. This led to the introduction of tanker and freighter variants, as well as an ACJ corporate version. And in 2008, 10 years on from the -200's debut, A330 orders passed the 1,000 mark.

Weight development had turned the larger A330-300 into a more capable machine as the sun set on the A340. Despite stretching and re-engining the quad, the world's airlines had moved on from four engines in that sector.

In the meantime, Boeing – which was seeing the A330 trounce its once-dominant 767 in the marketplace – responded aggressively with the launch in 2004 of the all-new 787 family. Airbus could be forgiven for believing this signalled the end of the original A330, and set about creating a major derivative equipped with new engines and upgrades.

It was dubbed the "A350", but after initial sales success, Airbus was persuaded that this warmed-up A330 did not go far enough to be a true long-term 787 challenger. So the project

was shelved in 2006 as the all-new "A350 XWB" emerged. Then a strange thing happened. Boeing ran into production delays on the 787 and Airbus found customers – both old and new – turning to its venerable A330.

"The launch of the 787 was the best thing that happened to the A330," says Hamilton.

Flight Fleets Analyzer data illustrates his point — since 2004 when the 787 was launched, Airbus has sold over 1,000 of the original A330-200/300 variants — a number that surprises Toulouse as much as Seattle.

With production being sustained well into the A350 era, Airbus found itself re-evaluating its decision not to re-engine the A330. It realised that a cost-effective competitor to the 787 could be created that could also solve the headache its smallest A350 variant was creating: the now defunct -800.

And so at Farnborough 2014, eight years after Airbus replaced the Mark 1 A350 with an all-new design, a second-generation A330 was launched as the Trent 7000-powered A330neo. The original schedule called for flight-testing to start in spring 2017, to allow deliveries to begin before year-end to launch customer TAP Portugal. But development delays, largely due to hold-ups at R-R, prevented the start of testing as A330neo airframes sat in Toulouse awaiting engines.

With flying now under way, Airbus and R-R face a challenging development programme to start deliveries under the revised schedule of mid-2018. But Hamilton is confident: "Things have happened outside of our control," he says. "But we've always been in close consultation with Rolls. They had the

"The launch of the Boeing 787 was the best thing that happened to the A330"

Crawford Hamilton A330 marketing chief, Airbus

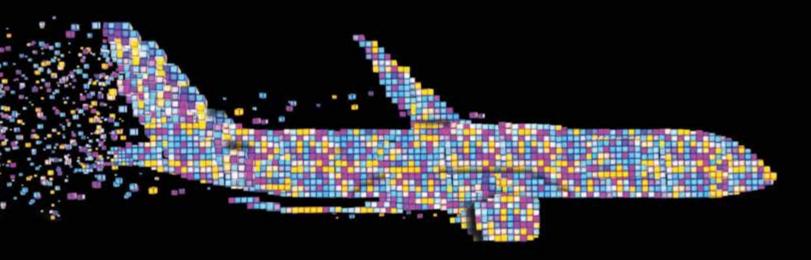
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A330neo key features





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From a sales perspective, the A330neo has had a strong start, securing 212 orders. Hamilton says sales are on track, despite a slow 2017 so far (to the end of October), with just two new orders announced (and four cancelled after TransAsia ceased operations).

HAWAIIAN HIATUS

One area of potential concern is the poor showing so far for the A330-800 variant, which has just six orders. These are all from one customer – Hawaiian Airlines – which has indicated it could review the order (itself a replacement for an earlier A350-800 contract).

But Hamilton is confident about the -800's potential, which is derived from the A330-200 airframe: "The A330-200 category has been doing well over the past few years. It's the most popular widebody [in operator terms] — we have 95 operators and 600 aircraft, and that's a heck of a base to have," he says.

"The A330 has good [cabin-configuration] versatility, good range, low trip-cost and from a financial point-of-view, it's low risk. For airlines that are growing, the logical first [widebody] step is the A330," adds Hamilton.

The future may be all about the A330neo, but Airbus is still building and selling the current variant. With over 100 -200/300s still to deliver from existing orders, Hamilton says Airbus "can still do the current aircraft, no problem. We've still got the MRTT, which is the most popular tanker. And we still have the A330-200 Freighter. They are aircraft that are still powered by the current engine, and we'll do them as long as anyone wants them."

The one cloud on the A330's horizon is the prospect of an all-new competitor from Boeing: its New Mid-market Airplane (NMA).

"We've got to be prepared," says Hamilton, who remains to be convinced that a market opportunity exists for an all-new aircraft.

"Boeing goes on about there being a gap in the market. But we don't see any 'gaps' because the A330 is filling them," he says. "The A330 has the versatility to do anything that any NMA can do, and more. Which gives it a very large appeal worldwide."

In other words: Boeing, bring it on.



First A330 took to the air on 2 November 1992



DEFENCE CRAIG HOYLE LONDON

Steady flow of orders for tanker adaptation

At the start of this century, the then-EADS began exploring the potential for its A330 widebody to deliver air-to-air refuelling (AAR) services for military operators. In doing so the company replicated its strategy for the airliner market by going head to head for international sales with Boeing, which held a virtual monopoly in the tanker sector.

Airbus had previously modified a handful of A310s for the tanker role, adapting the widebody to carry underwing hose-and-drogue refuelling pods. Flight Fleets Analyzer shows the air forces of Canada and Germany as still having two and four examples in use, respectively.

The convoluted future strategic tanker aircraft competition to replace the UK Royal Air Force's Lockheed TriStars and Vickers VC10s eventually led to success for the A330-200-based Voyager - although a 2004 selection of the AirTanker consortium did not lead to a contract award until four years later, and first delivery in September 2011. Three months earlier, the Royal Australian Air Force (RAAF) formally accepted its first locally designated KC-30A,

under a five-unit acquisition.

Canberra's selection involved the integration of an Airbus-developed, fly-by-wire-controlled aerial refuelling boom system. After significant delays with development and service acceptance, the RAAF debuted the boom capability on deployed operations in November 2015.

At one point it appeared as though Airbus had succeeded in its most audacious of sales pitches, when its partner Northrop Grumman was selected for the US Air Force's KC-X tanker deal in February 2008. After the decision was quashed following an appeal by Boeing, EADS North America led a second bid, before its rival's 767-based KC-46A was selected for the 179-aircraft requirement in February 2011. Boeing is due to deliver its first operational examples next year.

Flight Fleets Analyzer shows 24 A330 multi-role tanker/transports (MRTT) as being in active service, with Australia (6), Saudi Arabia (6), the United Arab Emirates (3) and the UK (9). A further five Voyagers were modified for use by the RAF and can be called on if needed to support "surge" operations.

The A330 MRTT can carry 111t of fuel, up to 300 passengers and under-floor cargo, and Airbus says the global fleet has amassed more than 125,000 flying hours.

Airbus has a healthy production backlog, with orders from France (9), Singapore (6), South Korea (4) and a group of NATO nations, which will field the type as a pooled capability via a European Defence Agency initiative. Germany, Luxembourg, the Netherlands and Norway have so far committed to seven aircraft, ordering two of these. The fleet could grow to 11 if more partners join.

India chose the A330 MRTT for a six-strong tanker deal, but is to stage a fresh competition, and Qatar has yet to advance a deal for two after a selection in 2014.

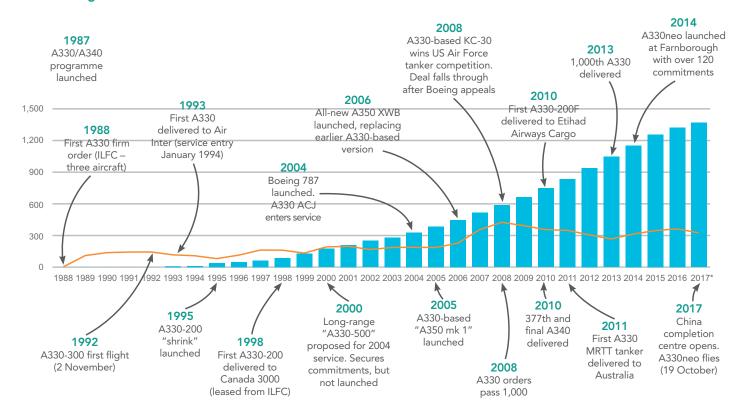
Future deliveries will be made in an enhanced configuration, which includes updated avionics equipment and aerodynamic improvements. The first such aircraft was flown in October 2016 and will be delivered to the Republic of Singapore air force. A lead example for France got airborne in September 2017 and will be delivered next year.



Staying power

As the Airbus A330 marks a quarter of a century, the twinjet is still going strong, with a second-generation, re-engined Neo variant now in flight-test. To mark the milestone, we examine the programme's key metrics with data from Flight Fleets Analyzer

A330 backlog and cumulative deliveries

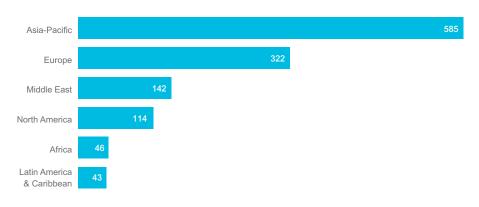


Source: Flight Fleets Analyzer Notes: Year-end backlog. *To October

Cumulative deliveries

Order backlog

A330 fleet by region



62 4

Of the 1,252 A330s in service, Turkish Airlines is the largest operator, with a fleet of 62 aircraft

Data for in-service aircraft only (all operators, including military) Source: Flight Fleets Analyzer

A330neo customers and operators



AirAsia X Variant: -900 Backlog:



Iran Air -900 Variant: Backlog: 28



Delta Air Lines -900 Variant: Backlog: 25



Avolon Variant: -900 Backlog: 21



Air Lease Variant: -900 Backlog: 19



TAP Portugal Variant: -900 Backlog: 18



Since its 1992 debut, Airbus has developed the A330 into a multi-variant family that comprises two sizes, passenger and cargo (left) versions as well as a military tanker and corporate jet. All the "big three" engine makers have participated on the programme,

KING TWIN

but Rolls-Royce leads, with a 63% share of the in-service fleet



Garuda Indonesia Variant: -900 Backlog: 14



Hawaiian Airlines Variant: Backlog: 6





Azul Variant: -900 Backlog: 5



Wow Air Variant: Backlog:



Air Mauritius Variant: -900 Backlog:



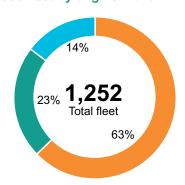
Variant: -900 Backlog: 2



AirCalin Variant: -900 Backlog: 2

Lessor orders that have been placed are shown against operator. Source: Flight Fleets Analyzer (October 2017)

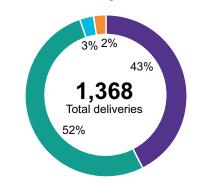
A330 fleet by engine maker



Data for in-service aircraft only (all operators, including military) Source: Flight Fleets Analyzer (October 2017)

Rolls-Royce **GE** Aviation Pratt & Whitney

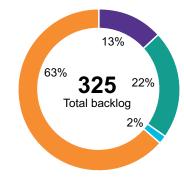
A330 deliveries by variant



Source: Flight Fleets Analyzer (October 2017)

-200	-300	-200F	MRTT
582	715	38	33

A330 order backlog



Data for all operators, including military. *Includes -200F/MRTT Source: Flight Fleets Analyzer (October 2017)

-200*	-300	-800	-900
43	70	6	206



Succession plan

Singapore Airlines is one of 32 existing A330-200/300 operators (with five or more aircraft) that is also a customer for the A350-900

he Airbus A330 has proven to be one of the most successful twin-aisle types ever. A quarter of a century on from its first flight, and with the second-generation A330-900neo now in the air, how are operators deploying the twinjet and what types might replace the existing fleets?

The first aspect to consider is that, despite 25 years of production, more than half of the current "A330ceo" (-200/300) passenger fleet was built after January 2010, and will not be retired for many years to come. However, many operators have already placed orders for newer types and others have leased aircraft that may exit their fleets once the initial 10- to 12-year leases expire. Flight Fleets Analyzer shows that about 150 known leases are due to expire between 2018 and 2022, an average of 30 a year.

There are just short of 1,200 A330s operating in passenger roles with 106 airlines worldwide. This includes 530 of the smaller A330-200 variant and 660 of the -300. The latter overwhelmingly consists of high gross weight aircraft, with just 36 of the original shorter-range A330-300s remaining.

The A330 reached its peak production rate of 10 per month only in 2013, with the type receiving a major boost from the delays suffered by the Boeing 787, which led to a number of airlines selecting A330s to fill the capacity gap.

However, all good things come to an end, and the ramp-up of the 787 to 12 aircraft per month, together with the entry into service of the A350-900, saw production of the A330ceo being reduced to six per month in 2016. While the 787 rate is increasing to 14 per month by 2019, the A330 rate looks unlikely to change after Airbus initially planned an increase back up to seven per month by 2019, during the transition to the re-engined A330neo.

Both versions of the original A330 are used ₹over a wide variety of missions and market

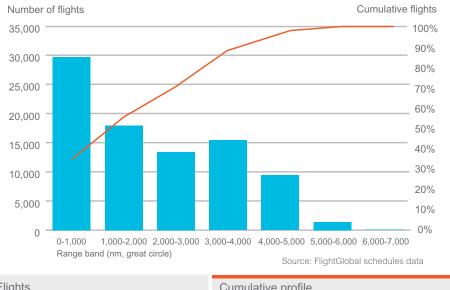
Richard Evans, senior consultant at Flight Ascend Consultancy, considers replacement strategies for first-generation Airbus A330s

sectors. The initial low gross weight A330-300s were primarily used on intra-Asian routes up to about 2,700nm (5,000km), as Airbus had pursued a strategy of offering the A340 for longer, intercontinental markets. The A330-200 "shrink" marked the first move of the type into long-haul operations and was successful at replacing the smaller 767-200/300 at several airlines. It has also seen widespread use among leisure carriers, often in a high-density layout with more than 300 seats. Until the advent of the 787-8, the A330-200 became the default type to launch new long-haul routes, or for those with thinner demand.

Airbus has steadily increased take-off weights for the A330-200 and -300, which, combined with engine and aerodynamic improvements, means the larger -300 now has sufficient range to fly many Asia-Europe and transpacific routes. A case in point is the use of A330-300s on many China-Europe flights, which were beyond the payload-range capability of the -300 until recent years and instead were flown by -200 variants.

However, analysis of FlightGlobal schedules data reveals that the A330's average sector

A330 flights by range band



Flights Cumulative profile length is about 2,000nm. This is well within the capability of the latest single-aisle types, including the largest variants – the A321neo and 737 Max 10. Therefore, for some airlines, these could also be considered potential replacements.

Smaller carriers will tend to look for a single type to replace their current fleets of A330s but, as airlines grow, the option of splitting a replacement across two types to better match aircraft sizes to market demand, and to reduce overall operating costs, becomes possible. In terms of pure cash-operating-cost per seat, it is very difficult for a twin-aisle type to better the cost of a large single-aisle type.

POTENTIAL REPLACEMENTS

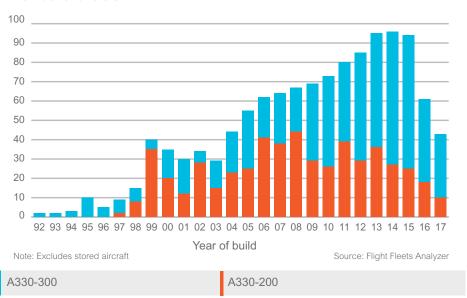
With regards to the in-service fleet, the top 29 operators of the A330 account for about two-thirds (800 aircraft) of the current airline fleet. Although there are several airlines with average stage lengths well below 2,200nm, all except Thai have at least one route that is beyond the realistic capability of large single-aisle types (around 3,000nm).

As illustrated below, the operator base includes many airlines that have already placed orders for types that could potentially replace their current A330 fleets. For the purposes of this article, this includes the 787-8 and -9, the A350-900 (with assumption that the A350-800 is not proceeding), and the A330-800/900.

There are 11 current A330 operators that have ordered 787s, and a further 13 that have ordered both 787s and A350-900s. This sug-

Build-year profile of A330-200/300 passenger fleet

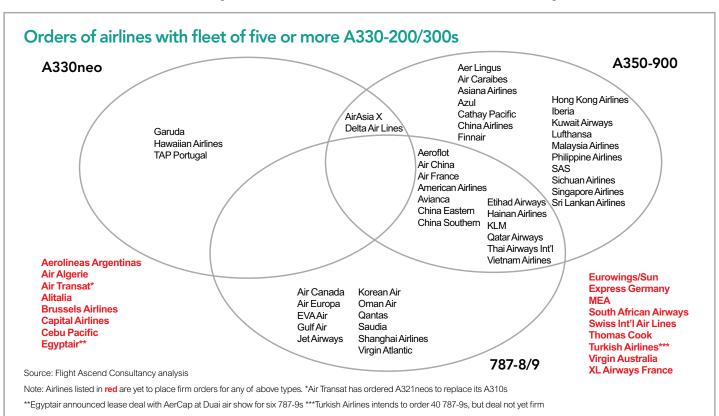
Number of aircraft



gests that the 787 will play a significant role in the A330 replacement market. For many operators, the A350-900 may be seen as overly capable in terms of size and range. This includes several major Asian operators, who generally use the A330-300 on routes up to 3,800nm. Their fleet plans are weighted towards growth as well as replacement, but this region would appear a key battleground for the A330neo. If the A330neo is not seen as the

optimal replacement for medium-haul A330-200s and -300s, then the current operator base could be very influential in determining the timing and design requirements for a new middle-of-the-market aircraft.

Of course, Airbus will be hoping that the only replacement for an A330 is another A330, but it appears that the 787, the A321neo and any new programme from Boeing will also be strong contenders in the 2020s.



Sparking off a revolution

A technology race is on to manage unprecedented levels of electricity for onboard systems, weapons and propulsion

STEPHEN TRIMBLE WASHINGTON DC

wo of United Technologies' (UTC) competitors, Rolls-Royce and Honeywell, teamed up in 2015 to design and build the 1MW-class hybrid-electric propulsion system for Aurora Flight Sciences' XV-24A Lightning Strike, in a pioneering unmanned air system study funded by the US Defense Advanced Research Projects Agency.

Another rival, GE Aviation, came out last August with a new white paper describing an intense effort over several years to harness extreme amounts of electric current to power future military payloads and propel hybridelectric aircraft.

In a largely behind-the-scenes race to fulfil the US military's expanding appetite for vast quantities of onboard electric power, only UTC's three business units – Pratt & Whitney, United Technologies Aerospace Systems (UTAS) and the United Technologies Research Center (UTRC) – remained quiet.

But UTC's silence is over. A new P&W white paper – released exclusively to Flight-Global – opens a window into a wide-ranging effort to meet the military's demand for more-electric and all-electric aircraft.

"Research efforts in electrification of air-

craft are likely to drive innovation that could have broad impacts across aviation," P&W says. UTC's divisions "are closely tracking trends in more electric and hybrid electric propulsion and power, and also working in key areas that we believe will be important".

The most modern US military aircraft already generate and consume vast amounts of electric power on board. Electricity is used to power increasingly sophisticated sensors, such as active electronically scanned array radars. Electric power also serves as a back-up for activating the control surfaces of the Lockheed Martin F-35. And, electricity is looked upon as a propulsion option for small UAS and large experimental drone projects, such as the XV-24A.

But US military officials already envision a future fleet of combat aircraft with even greater needs for onboard power. A new class of directed energy weapons, including lasers and high-power microwaves, is emerging as an option for the next generation of manned tactical fighters. So suppliers have to find new and creative waves to generate, store and distribute ever-escalating amounts of electricity, while managing unwelcome by-products such as waste heat.

Meanwhile, the same requirements are pushing existing technology up against the

s. Electric power also serves as a back-up tivating the control surfaces of the Lock-Martin F-35. And, electricity is looked as a propulsion option for small UAS arge experimental drone projects, such e XV-24A.

t US military officials already envision a effect of combat aircraft with even er needs for onboard power. A new class ected energy weapons, including lasers nigh-power microwaves, is emerging as

stubborn limits of the laws of physics. Certain phenomena – including the Corona effect, which turns air surrounding high-power cables into conductive plasma – threaten to prevent highly electrified aircraft from reaching the normal cruising altitudes of today's jet-powered aircraft. To overcome these and other obstacles, industrial players have made up long-term technology develoment plans. UTC can draw on expertise from all three divisions: P&W (engines), UTAS (electric power) and UTRC (experimental innovation).

Aircraft propulsion and power systems are often overlapping capabilities in the supply chain. In UTC's portfolio, UTAS already supplies the 1.4MW onboard power system for the Boeing 787, which uses electricity instead of hydraulics and pneumatics to pressurise the cabin and prevent ice from forming on the wing's leading edge. That electricity is generated by feeding compressed air from the engine to an accessory gearbox, which drives four variable-frequency starter generators; an auxiliary power unit remains on standby.

For military purposes, that is just the start. "Additional power will be needed as aircraft become more electrified," P&W says.

In GE's recent white paper, the company revealed a nearly two-year-old project that





demonstrated an ability to generate 1MW of electric power from a single fighter engine – the F110 – while continuing to produce thrust. To achieve that feat, the company could not take power solely off the high-pressure turbine module. In what appears to be an industry first, GE also extracted 750kW of power from the low-pressure turbine.

IN-FLIGHT BREAKTHROUGH

If the ground demonstration could be replicated in flight, it would be a breakthrough. While the high-pressure turbine is used to generate 250kW to serve a fighter's normal electric needs, the surplus 750kW from the low-pressure turbine could be used to supply power for lasers, high energy weapons and powerful new radars.

But P&W's newly released white paper is evidence that GE is not the only company pursuing such a capability. In an undated, joint demonstration with UTAS, P&W successfully extracted electric power from the low-pressure turbine of a mid-sized business jet engine, a market segment that describes the thrust range of the PW500 and PW600 engine families.

"The programme established performance and operability trends on a typical high bypass turbofan engine for low spool power extraction at sea level and high altitude operation," P&W writes in the white paper. "Testing demonstrated the capability to produce significantly (~4X) more electrical power than possible from the high-pressure spool alone, with no impact to engine operability and minimal impact to engine performance and fuel consumption."

Meanwhile, UTC's business units are also working to solve other problems posed by higher electrification in aircraft. As power generation demands escalate, so too does the requirement to store power in a primary or back-up device such as a battery or storage module. State-of-the-art lithium ion batteries fall short of the energy density needed to serve in this role, so the industry is experimenting with alternatives.

P&W's white paper reveals that the company partnered with Lockheed and the US Air Force Research Laboratory (AFRL) to design and demonstrate a hybrid energy storage module (HESM). Such devices use several possible components, including supercapacitors, secondary batteries and flywheels, for storing high-density energy loads.

The white paper says: "The UTC team performed requirements definition, trade stud-

ies, technology surveys and design, leading to fabrication and test of a HESM laboratory demonstrator. A prototype HESM was delivered to AFRL for testing at the end of the current effort, and plans are under way for additional development."

Finding ways to more efficiently store huge amounts of energy on an aircraft is only one of the challenges confronting the industry. By definition, a megawatt-sized generator that operates with 95% efficiency loses 50kW – 5% of its power – to, principally, heat. This will drive the industry to find new ways of managing the heat, which can overwhelm electrical components.

"P&W and UTAS are working on technologies to address cooling through UTAS's experience in air management and P&W's experience in propulsion system integration," its white paper says.

To generate megawatts of power on the ground is relatively simple. There are few constraints on the size and weight of generators, inverters, batteries and cables. One of GE's research goals is to develop a power inverter that can handle megawatts of electricity, yet weigh a fraction of similar ground-based devices while operating in harsher conditions and providing better reliability.

The biggest obstacle remains the Corona effect. This occurs when power cables are charged with extreme voltages at high altitudes. In those conditions, the air around the cable becomes a conductive plasma, creating the conditions for a dangerous short circuit. Modern aircraft routinely fly at altitudes above 30,000ft, where the Corona effect becomes most pronounced. Hybrid electric vehicles will need power in the megawatt range, meaning they will need to distribute power from the generator to the motor along cables carrying hundreds of thousands of watts.

No solution to this problem yet exists, but development of lightweight insulation materials is one promising approach.



GE has pulled 1MW of electric power from its F110 engine, while maintaining thrust



Renewed thrust

The A400M's TP400-D6 engines are distinguished by their power output and a string of technical troubles, but with apparent resolution the airlifter programme looks set to soar

CRAIG HOYLE LONDON

ight years ago, the first A400M took to the sky from Airbus Defence & Space's Seville final assembly site, powered by a quartet of Europrop International (EPI) TP400-D6 engines.

A consortium formed by the propulsion system champions of France, Germany, Spain and the UK to deliver the Western world's most powerful turboprop ever, EPI has faced multiple and complex challenges, since even before aircraft MSN001 soared over Spain on 11 December 2009. But with a key modification now awaiting approval, could the collaboration between ITP, MTU Aero Engines, Rolls-Royce and Safran Aircraft Engines finally be poised to rise clear of the turbulence experienced during more than a decade of

development and operational activities?

Partner nations Belgium, France, Germany, Luxembourg, Spain, Turkey and the UK signed a combined development and production-phase contract for the A400M in May 2003 via the OCCAR defence procurement agency. Deliveries of the tactical transport were targeted to begin in October 2009, but eventually commenced in August 2013, when the French air force took the first of a combined 170 aircraft on order for the European operators.

The outcome of a selection decision made by the partner nations, the 11,600shp (8,650kW)-output TP400-D6 was among the factors behind the almost four-year slip in service introduction.

It is more than a decade since the TP400 entered testing, with the design having under-

gone its first ground run on a test stand in March 2006. Flight trials using a Lockheed Martin C-130K testbed commenced in the UK during December 2008; only one year before first flight aboard the programme's lead "Grizzly" test aircraft.

Challenges facing the EPI partners and Airbus have included the need to achieve civil type certification of the TP400 by the European Aviation Safety Agency — a milestone achieved in May 2011. Problems ranging from in-flight shutdowns to cracking within the propeller gearbox (PGB) affecting Avio Aerosupplied equipment on some engines due to excessive vibration served to disrupt operations and affect the A400M's delivery rate.

This remains a clear source of frustration for Airbus Group chief executive Tom Enders. Speaking on the eve of this year's Paris air show, he referred to his company's past decision to accept full liability for the A400M's propulsion system – leaving it open to paying liquidated damages in the event of delivery delays - as "an incredible blunder".

Despite its ongoing challenges, the A400M has enjoyed some positive headlines recently, including delivery of a 50th production example - to the Luftwaffe on 29 September and the in-service fleet having passed a combined 100,000h of engine operating time.

With a distinctive, 5.3m (17.4ft)-diameter propeller, the TP400 features a three-shaft architecture, with full authority digital engine control from Safran Electronics and Defense. It can be operated at up to 40,000ft, gives the Atlas a maximum range potential of 4,800nm (8,900km), and total payload capacity of 37t.

GAINING BACKBONE

"The A400M is steadily becoming the backbone of the European transport fleet," says Airbus. Deliveries have been made to the air forces of France, Germany, Spain, Turkey and the UK, plus export user Malaysia. Earlier this year, it handed over its first example with much-needed tactical performance, including an initial self-protection suite.

While its tactical functionality continues to evolve, the Atlas is becoming an increasingly relied-upon logistical transport asset. The UK uses the type to transfer equipment to the Royal Air Force's Akrotiri base in Cyprus, as coalition activities continue over Iraq and Syria. The RAF has also this year deployed the Atlas to countries including Australia, Malaysia and New Zealand, and delivered humanitarian relief supplies to the Caribbean following two devastating hurricanes. The French air force, meanwhile, uses its aircraft to fly logistics missions to locations including in Africa and Latin America.

EPI had delivered more than 210 TP400s by July 2017, and says its project employs 2,500 people around Europe. Safran has the largest stake, at 32.2%, followed by R-R (25%), MTU (22.2%) and ITP (20.6%). Final assembly of all engines is performed by MTU at its facilities near Munich, Germany.

In-service support for the operational TP400 fleet is being provided by EPI partner companies at Orléans, France, Wunstorf, Germany, Zaragoza, Spain, Kayseri, Turkey, RAF Brize Norton in the UK, and at a Royal Malaysian Air Force facility near Kuala Lumpur.

Such on-base maintenance capabilities are backed up by dedicated facilities capable of working on the powerplant in Chatellerault (Safran), Munich (MTU), Madrid (ITP) and Bristol (R-R), and by Safran's Global Turbine Asia (GTA) joint venture in Subang, Malaysia.

MTU on 10 October announced its receipt of a five-year support deal from the German air force, describing this as an "all-encom- | Source: Flight Fleets Analyzer



Europrop International hopes to leave TP400's troubles behind with permanent gearbox fix

passing maintenance concept". "We are the first certified company to maintain the TP400-D6 based on civil maintenance, repair and overhaul procedures," it notes.

Under the arrangement, Luftwaffe personnel will perform on-wing maintenance and repair work, while MTU will deliver more complex, off-wing support services. "The aim of the maintenance concept is to guarantee the German armed forces receives efficient maintenance services tailored to their operational requirements," the company says.

LOCAL KNOWLEDGE

Ahead of the March 2017 LIMA air show in Langkawi, Safran announced a new in-service support arrangement with the Royal Malaysian Air Force, which has received its full complement of four A400Ms. The second phase of this deal came into effect on 1 November, with GTA assuming the role of prime contractor. The contract will "ensure that the Royal Malaysian Air Force continues to receive timely support for its engines" via a "successful partnership", Safran says.

Meanwhile, EPI is working towards a permanent fix for a cracking issue affecting the Avio-supplied PGB on some right-hand gearboxes only, due to the A400M's use of a socalled "handed" configuration for its TP400s.

A400M orders and deliveries

Nation	Active	Ordered
Belgium		7
France	11	39
Germany	13	40
Luxembourg		1
Malaysia	4	
Spain	1	26
Turkey	5	5
UK	18	4
Total	52	122

A "truncated plug solution" developed as an interim fix was certificated in July 2016 and has since been retrofitted to all in-service aircraft and installed on new engines since the start of this year. EPI says this is providing "strong relief to the operators", by removing the need to conduct on-wing inspections of the gearbox after every 20 flying hours. "This configuration is performing as expected on the fleet in service," it adds.

Work to develop a permanent fix through a "Pack 2" series of enhancements had been targeted for certification by EASA during the third quarter, but the consortium confirms that this schedule has been extended.

EPI says it wants to provide "a fully mature PGB configuration, which requires extensive analysis, rig and full engine tests. Consequently, we plan to achieve certification at the beginning of 2018."

The enhancements mainly consist of modifications to reduce vibration levels, and will "reinforce endurance and reliability".

For Airbus, the resolution of engine issues and the introduction of contractually promised tactical capabilities can only serve to boost its chances of securing fresh export interest in the A400M.

OCCAR has previously outlined a plan for deliveries of the Atlas to conclude during 2024 under Europe's 170-aircraft production commitment, but Airbus remains in discussion with its customers about this schedule and easing the pain of financial penalties currently being borne by the company.

Speaking during a third-quarter results briefing in late October, Airbus chief financial officer Harald Wilhelm indicated that output this year would be in line with the number of shipments made in 2016. This adjustment will allow the company to focus on delivering the type to the programme's core nations, and "gives a bit more time to catch the export orders in the outer years".

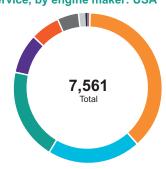
Power players

When it comes to the effectiveness of air forces, aircraft numbers tell only a small part of the story – performance matters above all and, as this dip into the Flight Fleets Analyzer database highlights, it is no surprise to find that the big names in aero engines have built substantial market share positions in the world's military fixed-wing and helicopter fleets



Enduring appeal of Mirage 2000-series fighters keeps Safran's M53 engine flying high

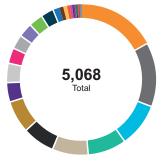
Military fixed-wing aircraft in service, by engine maker: USA



Source: Flight Fleets Analyzer

GE Aviation	Honeywell (Garrett)
Pratt & Whitney Canada	Textron Lycoming
Pratt & Whitney	Ivchenko (ZMKB Progress)
Rolls-Royce Allison	Rolls-Royce Deutschland
CFM International	Turbomeca-Safran
Rolls-Royce	

Military fixed-wing aircraft in service, by engine maker: Europe*



Source: Flight Fleets Analyzer *Excluding aircraft in service with Russia

GE Aviation	NPO Saturn
Rolls-Royce	WSK-PZL Rzeszow
Pratt & Whitney Canada	Europrop International
Pratt & Whitney	CFM International
Eurojet Turbo	Honeywell
Textron Lycoming	GE Business & GA
Safran	Omsk (Mars)
Rolls-Royce Allison	Aviadvigatel (Soloviev)
Honeywell (Garrett)	Motor Sich
Volvo Aero Norway	Teledyne Continental
Soyuz	Rolls-Royce Deutschland
Ivchenko (ZMKB Progress)	Rotax
Turbomeca-Safran	Lotarev (ZMKB Progress)
Klimov	ZMKB Progress

Military helicopters: world fleet by engine supplier

Manufacturer	Aircraft in service	Market share
GE Aviation	5,430	25.7%
Klimov	4,138	19.6%
Safran	3,367	15.9%
Honeywell	2,605	12.3%
Rolls-Royce Allison	2,541	12.0%
Pratt & Whitney Cana	da 918	4.3%
Klimov (Isotov)	624	3.0%
Safran (Turbomeca)	474	2.2%
Zhuzhou	284	1.3%
Rolls-Royce	212	1.0%
Other	535	2.5%
Total	21,128	

Military helicopter engines: top types

Source: Flight Fleets Analyzer

Manufacturer	Туре	Aircraft in service	Market share
GE Aviation	T700	5,016	23.7%
Klimov	TV3-117	3,797	18.0%
Rolls-Royce Allison	250	2,074	9.8%
Honeywell	T53	1,763	8.3%
Safran	Arriel	1,047	5.0%
Honeywell	T55	813	3.8%
Pratt & Whitney Canada	PT6T	744	3.5%
Safran	Astazou	540	2.6%
Safran	Makila	457	2.2%
Safran	Arrius	451	2.1%
Klimov (Isotov)	TV2-117	383	1.8%
Safran (Turbomeca)	RTM322	336	1.6%
Safran	Artouste	328	1.6%
Safran	Turmo	303	1.4%
GE Aviation	T64	280	1.3%
Rolls-Royce Allison	AE 1107	244	1.2%
Klimov (Isotov)	GTD-350	241	1.1%
Rolls-Royce Allison	T63	223	1.1%
Klimov	VK-2500	176	0.8%
Zhuzhou	WZ-8	175	0.8%
	Others	1,737	8.2%
Total		21,128	

Total 21,128
Source: Flight Fleets Analyzer

Military fixed-wing aircraft: world fleet by engine supplier

Manufacturer	Aircraft in service	Market share
GE Aviation	5,758	18.3%
Pratt & Whitney Can	nada 4,503	14.3%
Pratt & Whitney	3,354	10.7%
Rolls-Royce	2,044	6.5%
NPO Saturn	1,919	6.1%
Rolls-Royce Allison	1,842	5.9%
Soyuz	1,431	4.6%
Ivchenko (ZMKB Pro	ogress) 1,356	4.3%
AVIC Guizhou Liyan	g 1,083	3.5%
Honeywell (Garrett)	999	3.2%
Klimov	985	3.1%
Safran	870	2.8%
Textron Lycoming	854	2.7%
AVIC Shenyang Lim	ing 615	2.0%
CFM International	565	1.8%
Aviadvigatel (Solovie	ev) 490	1.6%
Eurojet Turbo	463	1.5%
Turbomeca-Safran	278	0.9%
AVIC Xian	220	0.7%
Volvo Aero Norway	208	0.7%
Others	1,548	4.9%
Total	31,385	

Source: Flight Fleets Analyzer





AL-31s from NPO Saturn power Sukhoi's Su-27 fighter, along with China's Chengdu J-10 $\,$





Pratt & Whitney Canada's PT6A turboprop gives Beechcraft's armed AT-6 plenty of bite

Military fixed-wing aircraft engines: top types

Manufacturer	Туре	Aircraft in service	Market share
Pratt & Whitney Canada	PT6A	3,944	12.6%
Pratt & Whitney	F100	2,414	7.7%
GE Aviation	F110	1,587	5.1%
NPO Saturn	AL-31	1,443	4.6%
GE Aviation	J85	1,350	4.3%
Rolls-Royce Allison	T56	1,144	3.6%
GE Aviation	F404	1,096	3.5%
Shenyang	WP-7	1,081	3.4%
Rolls-Royce	Adour	875	2.8%
Klimov	RD-33	821	2.6%
GE Aviation	F414	683	2.2%
Ivchenko (ZMKB Prog)	AI-25	660	2.1%
CFM International	CFM56	565	1.8%
Soyuz	R-13	528	1.7%
Soyuz	R-195	498	1.6%
NPO Saturn	AL-21	476	1.5%
Aviadvigatel (Soloviev)	D-30	475	1.5%
Eurojet Turbo	EJ200	463	1.5%
Honeywell (Garrett)	TPE331	450	1.4%
Honeywell (Garrett)	TFE731	444	1.4%
Safran	M53	422	1.3%
	Others	9,966	31.8%
Total		31,385	
Source: Flight Fleets Analyzer			

Source: Flight Fleets Analyzer

From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

Asterisk management

Airbus limited its A350 presence at last week's Dubai air show to the -900, rather than the soon-to-be-delivered -1000 with which it hopes to wrest the "bigtwin" crown from Boeing's 777-300ER.

There could, of course, be all sorts of reasons for this. But it's worth noting that the first delivery – due next month – is going to ***** Airways, currently linea caeli non grata in the United Arab Emirates.

Since the UAE is rather sensitive over the whole ***** issue, to the point of being prepared to jail and heavily fine sympathisers, we're going to restrict our mentions of the carrier concerned. Although we should probably point out that this isn't what **** Airways means when it calls itself a "five-star airline".

Al inclusive

Talking – or not – about the airline that shall not be named, in Dubai at least, we hear that a certain Doha-based chief executive may take advantage of his Abu Dhabi rival's problems with its overseas investments by rebranding his latest subsidiary Meridiana as Al Italia.

Under the blanket ban

At Dubai, Emirates chief Sir Tim Clark found himself having to address queries as to whether the new first-class suites on its Boeing 777-300ER contained sleeping arrangements capable of accommodating more than one occupant.

"Are you being Victorian about it?" came the question from the floor.

Sir Tim pointed out that the size of the suite was sufficient for travelling companions to enjoy one another's company. "But I don't think the bed is big enough for two," said the, er, good knight.



Etihad Airways is pictured *Cezanne* the opportunity to add its own touch of glamour to the opening of the new Louvre Abu Dhabi art museum. Visitors were able to *Marval* at the sight of the aircraft as its crew *Rodin* for a low-level pass, underlining the carrier's official partnership agreement with the institution, before *Gauguin* back to base. The Toulouse-built A380 involved in the flyby – a sort of *Toulouse low trek*, if you like – carries the Jean Nouvel-designed museum's logo on each of its four Engine Alliance GP7200 engines as part of the promotion. Abu Dhabi's government apparently paid hundreds of millions of dollars for the right to adopt France's world-famous Louvre name – clearly putting the emirate's *Monet* where it thinks it really *Matisse*.

Alarm Bells

The Donald's recent trade mission to China paid dividends for US manufacturer Bell, with a further 50 orders for its 505 light single. All good for President Trump's America First policy.

Mind you, perhaps the celebrations will be more vigorous elsewhere: the Textron subsidiary manufactures the 505 in Montreal, Canada, using Arrius 2R powerplants supplied by France's Safran.

Height International

A few years back we published a photo of Alan Rickard enjoying his favourite aerospace weekly on Africa's highest peak.

He has gone one better with this, taken at Mt Everest base camp, 17,500ft above sea level. "You were good enough to publish a similar picture while I was at the summit of Kilimanjaro," he says. "It would be good to do the double."

Christmas get-together

The venue for Bombardier's traditional press festive lunch in London is Dartmouth House, which bills itself as an "events, conference and wedding venue in the heart of Mayfair" – an apt location given the upcoming nuptials with Airbus.



A mountain of reading

US war chest

The Aero Club of America has passed a resolution



urging Congress to appropriate not less than £200 million for

building an emergency air fleet of huge warplanes as an offset to the mobility of the Germans on interior lines of communication.

Call the cavalry

The overwhelming nature of the disaster which



has befallen Field-Marshal Rommel's Afrika Korps has been

mainly due to the "cavalry" tactics of the Allied air squadrons in the pursuit.

Counting the cost

Devaluation will increase the already heavy cost



of importing
American aircraft
and equipment.
Overnight the

cost of BOAC's second order for 747s goes up by the equivalent of one aircraft, and the planned defence cut of £100 million will be more than swallowed up by the increased cost of F-111Ks and Phantoms.

ILFC's big deal

International Lease Finance is planning the biggest civil



aircraft order since GPA placed a \$17 billion contract

for 300 aircraft in 1989. The Los Angeles-based company is negotiating with Airbus Industrie and Boeing on a combined order for as many as 90 new aircraft for delivery from 1996 onwards.

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EVENTS



6-7 December

Aerospace Big Data London, UK flightglobal.com/bigdata

8-12 January 2018 AIAA SciTech Forum Kissimmee, Florida, USA scitech.aiaa.org

23-25 January Annual Global Airfinance

Conference Dublin, Ireland euromoneyseminars.com/ global-airfinance-dublin

5-7 February

Loyalty 2018
Bangkok, Thailand
flightglobalevents.com/ loyalty2018

11 February

Singapore Airshow Changi, Singapore singaporeairshow.com

15 February

Routes Americas Quito, Ecuador routesonline.com

February-1 March HAI Heli-Expo

Las Vegas, Nevada, USA heliexpo.rotor.org

IEEE Aerospace Conference Big Sky, Montana, USA aeroconf.org

15 March

-10 March

IATA World Cargo Symposium Dallas, Texas, USA iata.org

18-20 March

Routes Asia

Brisbane, Australia routesonline.com

10-12 April

Aircraft Interiors Expo

Hamburg, Germany aircraftinteriorsexpo.com

18-21 April

Aero Friedrichshafen Friedrichshafen, Germany aero-expo.com

April

ILA Berlin Air Show

Berlin, Germany ila-berlin.com

8-10 May

AIAA Defence Forum Laurel, Maryland, USA

defense.aiaa.org

1 May

EBACE

Geneva, Switzerland ebace.aero

3-15 July

Royal International Air Tattoo RAF Fairford, Gloucestershire, UK airtattoo com

16-22 July

Farnborough International Airshow

Farnborough UK farnboroughinternational.co.uk



For a full list of events see flightglobal.com/events

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- Applicants must hold a valid European Union Air Traffic Controller Licence issued by the UK Civil Aviation Authority and a European Class 3 Medical Certificate
- Ratings in ADI/TWR and APP with previous validations at a unit are essential
- Possession of a Certificate in Aeronautical Meteorological Observing issued by the UK Met Office is desirable

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Application details can be obtained from the Human Resources Department by contacting liz.hughes@cityofderryairport.com or visiting www.cityofderryairport.com

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WORK EXPERIENCE DAWIT LEMMA

Building the big picture in Ethiopia

Working at Ethiopian Airlines, Dawit Lemma realised he did not want to limit his horizons to one role, and so launched Krimson, where he is also active in developing the nation's business aviation sector

How did you get into aviation?

I distinctly remember that at aged seven my best friend and I decided we would be either pilots or cowboys, as adults. My parents suggested being a cowboy was not a "career choice" and encouraged my love and passion for airplanes, with a Lego Technic aviation set. This awakened my engineering and technical interest for aircraft, which I eventually developed at Purdue University, where I studied aeronautical engineering and flight technology. I also received a Federal Aviation Administration commercial pilot licence and airframe and powerplant mechanic licence. I rounded out my education with a Master's degree in aviation management.

What does your career in aviation look like to date?

My first job was as an operations intern at Detroit-Metro International airport, where I worked on the parallel runway design team. Since then I've spent time working for Landrum & Brown at Chicago O'Hare, supporting humanitarian flights for NGOs in Afghanistan, and working with maintenance teams at TAG Aviation in Geneva. A pivotal moment came when I was recruited by Ethiopian Airlines. When asked, "Do you want to be a pilot, a mechanic or a manager?", I replied: "All the above." They replied: "Choose one." I realised that only business aviation would allow me to fly the aircraft on Monday, fix it on Tuesday, and manage the company from



Lemma says AfBAA membership has raised government awareness

Wednesday to Sunday. So I set up Krimson Aviation in 2015. The first thing I did was call the African Business Aviation Association (AfBAA), to say that Krimson would be the first Ethiopian member.

Why did you get involved with the AfBAA?

In Ethiopia, there was no real understanding of business aviation, therefore it was imperative to create awareness to grow the sector. The 2015 regional symposium, held in Addis Ababa, successfully opened the eyes of government and regulatory bodies. In 2016, we launched the AfBAA Ethiopia Chapter.

What does your working week look like?

A typical week for me includes supervising business aviation

flights for our clients; as Bole airport is 24h, it is not uncommon to find myself, caffeine-infused, on the ramp at 02:00 waiting for an aircraft to arrive/depart for its technical stop and then returning home at 04:00 before starting a full day at the office. In addition to Krimson, as AfBAA director of membership and events, I also spend a healthy portion of my week working with the executive committee, planning events such as the African Business Aviation Conference and Exhibition.

What is the most challenging part of your work?

Working in Africa is not easy. However, that is part and parcel of why I started Krimson – to make change. We face policy changes, lack of adequate infrastructure and an absence of corporate governance. Communication and time management are other issues that hamper progress. What is the future for business

What is the future for busine aviation in eastern Africa?

Economies in the region are rapidly developing, therefore demand for business aviation as a tool and economic driver is high. There is also increased activity in other non-traditional business aviation sectors, such as tourism and medical evacuation. A factor that will help sustain growth is the strong commercial airline sector, which supports a culture of aviation.

What do you enjoy most about life at Krimson?

Developing and cultivating a business aviation sector in Ethiopia. This "big picture" approach has allowed me to engage with senior government officials, operators, media, and other stakeholders to create awareness and drive innovative ideas. My involvement with the AfBAA fulfils my desire to participate and contribute in the advancement of business aviation on the continent, through the relationships and networks I have forged, or by sharing my global experience with my African counterparts.



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